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SOME ASPECTS OF POTASH MANURING OF PASTURES.

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POTASSIC fertilizers take a minor place among artificial manures in New Zealand as compared with most other countries, particularly those in Europe. For instance, in relation to the amount of phosphate used, the comparative figures for New Zealand and a few other countries are approximately as follows:—

Country.	Ratio of Phosphoric Acid (P_2O_5) to Potash (K_2O) used.*	
	P_2O_5.	K_2O.
New Zealand	30 to 50	1
Italy	7	1
Switzerland	$3\frac{1}{2}$	1
Great Britain	3	1
Sweden	$2\frac{1}{2}$	1
France	$1\frac{1}{2}$	1
Germany	$\frac{1}{2}$	1

* Adapted from tables in *The Fertilizer, Feeding Stuffs, and Farm Supplies Journal, N.Z. Jour. Agric.*, and Year-Book of International Inst. of Agric., Rome.

The wide difference is no doubt due to the systems of farming, since the countries contrasted with New Zealand are largely arable, and such potash-demanding crops as sugar-beet and potatoes form an appreciable part of the area under cultivation. Nevertheless, it is significant that the potash-producing countries Germany and France are the chief users of the material in its "artificial" form, although a perusal of literature and photographs, particularly from Germany, almost suggests that providence has mercifully placed deposits of potash where they are likely to be most needed.

TREND OF POTASH MANURING IN NEW ZEALAND.

The quantities of potash fertilizers imported into New Zealand fell considerably from 1929 to 1934. This is attributable largely to the lower purchasing-power caused by economic conditions and the increased cost of potassic fertilizers brought about by exchange and other import restrictions. In spite of this, some farmers have

steadfastly continued to use potash in addition to phosphates, but many who had hitherto incorporated it into their manuring practice preferred to reduce expenditure by cutting out the use of potash, and used only phosphatic fertilizers or phosphates with lime, and even reduced their applications of these materials. This reflects the attitude of the New Zealand farming community generally to manuring practice—*i.e.*, phosphate, by reason of its spectacular effect in converting poor pasture into good and its known ability to increase appreciably the stock-carrying capacity of most farms, is indispensable. Potassic and nitrogenous fertilizers, on the other hand, are viewed as mere accessories to increase production over and beyond the initial improvement effected by phosphates.

It is generally considered that far more phosphoric acid than potash is removed in the major products from New Zealand farms, but in the removal of meat, wool, wheat, butter, cheese, potatoes, and milk for human consumption* approximately 10,000 tons of potash (K_2O) are taken annually, as compared with 14,000 tons of phosphoric acid (P_2O_5), a ratio of 1 to 1·4. Milk for butter and cheese manufacture has been included in the estimate, but most of the fertilizing elements from milk for manufacture of these are returned to the farms, although not necessarily to the land, by way of separated milk and whey. The position, then, is of interest if viewed from the angle that in 1934 about 72,000 tons of phosphoric acid (P_2O_5) and about 2,000 tons of potash (K_2O) in artificial fertilizers went on to farms in New Zealand, while over 14,000 tons of P_2O_5 and more than 10,000 tons of K_2O were removed in the main products for human consumption. It is realized, of course, that such data cannot be taken as a criterion of the immediate fertilizer needs of our farm crops, but, on the other hand, it is obvious that this state of affairs cannot continue indefinitely, and that, sooner or later, potash manuring must take a more prominent place in fertilizer practice.

It has been stated frequently that New Zealand soils are generally well supplied with available potash, and it is quite obvious that on most soil types this element is in much greater supply than is available phosphate. In certain areas, however, assuming that soil analysis is a reliable guide, there are indications that no great surplus of potash exists, and it is on these that potassic fertilizers are likely to become necessary in the near future. The reliability of soil analysis in this connection will be discussed later.

The Need for Potash Manuring on Pastures.

Under normal conditions grass takes up about four times as much potash as it does phosphate. Hudson(1) estimates that if all the herbage from a pasture producing 5,000 lb. of dry matter a year were removed it would be equivalent to the taking-off of 55 lb. lime (CaO), approximately equal to 98 lb. of carbonate of lime; 37 lb. phosphoric anhydride, approximately equal to 185 lb. of superphosphate; 150 lb. of potassic oxide, approximately equal to 500 lb. of 30-per-cent. potash salts; 150 lb. nitrogen, approximately equal to 750 lb. sulphate of ammonia. He further stated that

* Estimated from production figures for 1934 N.Z. Year-book, A. and P. Statistics, and based on tables in the "Agricultural Notebook" (McConnell) and "Feeds and Feeding" (Henry and Morrison).

under stock-grazing the amount returned to the pasture through the animal varies according to whether young stock, milking-stock, or mature dry stock are used. In the case of mature dry stock it is considered that most of the lime, phosphate, and potash, and a large proportion of nitrogen, is returned. The potash returned to the land through the stock is in a highly available form, and is easily utilized by the next generation of plants. Russell(2) states: "Dairy cows permanently remove more potash than bullocks, as also do growing sheep for their wool. This is shown by the fact that the quantities, in pounds, of potash (K_2O) removed annually per acre in a grazing season are bullocks, 250 lb. live-weight increase, 0·5; dairy cattle, 300 gallons milk, 5·0; sheep, 200 lb. live-weight increase, 30 lb. wool, 2·0. Heavy soils can supply all the potash needed, but light soils continuously used for sheep-grazing may ultimately fail to do so, and dressings of kainit may become necessary when the yields of mutton and of wool are being increased by basic slag. Where a hay crop is annually removed the supply of potash decreases, and unless more is added the yield falls to a lower level both in quantity and in value. The clovers especially suffer, having less power than some of their competitors to take potash from the soil, and, as they diminish, weeds come in to take their place." Thus, from the above, farms which may be first expected to show deficiencies of potash are those on light land, while fields which are most likely to respond to added potash are those which are repeatedly cut for hay.

Top-dressing Trials with Potash.

One of the major activities of the Fields Division of the Department of Agriculture is the carrying-out of simple observational trials on pasture to determine the main plant-food deficiencies in various districts, and since 1924 approximately 700 trials have been laid down throughout the Dominion. These trials are simple in design and rely wholly upon the visible differences apparent at the time of the Instructor's visit, which takes place about every two or three months. Included in the treatments are potash alone, phosphate (either super or slag) plus potash, and phosphate plus lime plus potash. Potash is applied annually in the form of 30 per cent. salts at the rate of 2 cwt. per acre, phosphate in its various forms at 2 cwt. or 3 cwt. per acre, and lime as carbonate at 1 ton per acre in the first year, with 5 cwt. per year subsequently.

Potash alone has given responses in only a very limited number of trials, and these have usually been apparent when the experiments were laid down on fields which were heavily phosphated previously. Occasionally, potash alone has proved detrimental to the general vigour of the sward, and in one trial in Poverty Bay the sward in the potash plot took on a most peculiar discoloured appearance, the grass assuming a brownish-purple colour and the clovers disappearing altogether. The addition of phosphate very largely counteracted this effect. In certain districts potash added to phosphate increases the production or improves the sward markedly as compared with phosphate alone. There is also a certain number of trials in which, although no appreciable effect is produced by the addition of potash to phosphate, marked results

are obtained by the combination of potash with phosphate and lime. Bell(3) comments on this freely in his review of potash responses in Auckland Province.

Characteristics of Potash Effect.

In the subsequent remarks the effectiveness of potash refers to that brought about by 30 per cent. potash salts in addition to phosphate as compared with phosphate alone. The general effects of potash on the sward described by Bell are typical of those in most trials where this material has given visible results. Firstly, there is an increase in growth of all the clovers present. Secondly, the white clover eliminates the annual species and covers bare-ground spaces. Finally, the better grasses, if these were originally present, are improved as a result of the vigour of the white clover, forming a well-balanced sward of grass and white clover. This, in effect, is the same process of improvement wrought by phosphates in building up a sward after initial top-dressing. On a good sward the amount of growth is sometimes increased, and this is apparent when some of the trials are closed for hay. Almost invariably where there is a potash response a definite preference is shown to those particular plots by grazing animals. This palatability must not be confused with the partiality shown by stock to pasture immediately after it has been dressed with 30 per cent. potash salts or kainit, since the latter is largely due to the sodium chloride (present as impurity), which is particularly appetizing. The real ultimate palatability is probably associated with a higher potash content of the herbage as well as a greater clover content of the sward, and this takes place some time after application. Potash responses may be distinctly regional in their occurrence, sometimes they can be correlated with a definite soil type, in other cases climatic conditions play a large part, since heavier rainfall conditions appear to exert some influence.

"Potash-response" Districts.

North Auckland.—Some good results from potash top-dressing have occurred on the peaty sands, on the red-brown soils derived from basalts, and on some of the mature podsols known as sandy gum lands. These types are scattered throughout the North Auckland Peninsula.

South Auckland.—Soil types similar to the North Auckland ones mentioned are found in the Manukau and Franklin Counties, and similar results have been obtained from potash except on the volcanic soils, where there is considerable variation in regard to response. In one or two experiments striking results have been obtained; in others, apparently on the same soil type, the results have been negligible.

Waikato.—As the soil types of the Waipa County have been accurately mapped by the soil survey, it has been possible to lay down a number of trials on given types. So far results favourable to potash have been secured on three trials on the Horotiu sandy loam, one trial on Kaipaki sandy peat, and one trial on the Hamilton clay loam.

Waihi.—Potash responses in this district have probably been more marked than in any other area surveyed, not only by the degree but also by the quickness with which they become apparent. Bell(3) considers

that these results are confined to the sandy loams and do not occur on the alluvial soils. The rainfall in this district is exceptionally high.

Taranaki.—A large series of experiments laid down throughout Western Taranaki have indicated that potassic fertilizers give favourable responses generally. The latter do not seem to be correlated with any particular classes of the three main volcanic showers as demarked by Grange and Taylor(4). Those trials located in North Taranaki appeared to show responses very quickly, more particularly in the high-rainfall belt close to Mount Egmont. In South Taranaki the results from potash have not been so consistent, nor have they been so quickly apparent as in the more northerly trials, but in a few cases quite striking results have occurred in the second and third years of the experiments. Two grazing trials in which potash-treated fields were compared with those receiving no potash, both receiving phosphate, were laid down in Taranaki in 1934. So far, two applications of 30 per cent. potash have been made. In the first season increases in grazing-days of 10 per cent. and 23 per cent. respectively could be attributed to potash, while in 1935–36 the increases were in the order of 62 per cent. and 17 per cent. respectively. The improvement in the sward on the two potash areas has been consistent throughout the period over which the trials have been conducted.

Southland.—Some of the experiments in Southland have already been summarized by Tennent and Stuart(5), who reported that the number of trials indicating responses from potash was high in Eastern Southland, while a few very good results had been obtained in Western Southland. In the former district potash was most consistently effective in the Mataura Valley, where excellent results from its use as a top-dressing material have been recorded.

Raetihi.—Fairly definite results were secured in a few trials in the Raetihi district, the soil of which, according to Grange(6), is formed from a volcanic shower of andesite.

Other Districts.—Isolated instances where potash was effective occur in other districts, but either they are not substantiated by like results or sufficient trials have not been laid down to definitely refer to these areas in the same manner as the foregoing.

In the following districts only a small proportion of trials has given visible results from potash, and, when apparent, they have been slight or spasmodic: Bay of Plenty, Poverty Bay, Hawke's Bay, Manawatu, Marlborough, Westland, Canterbury, and Otago. Results of trials in many of these districts have been published(5), (7), (8), (9), and (10).

It must be emphasized that since potash alone applied to a grassland sward has generally failed to show appreciable results, the effects quoted above are those from potash plus phosphate as compared with phosphate alone, or those from potash plus phosphate plus lime as compared with phosphate plus lime. Therefore, if phosphate, with or without lime, gives marked results over no treatment, any extra impetus given to growth by the addition of potash may be difficult to see. On the other hand, if phosphate, with or without lime, produces little change over no treatment, there is more chance of any extra improvement caused by potash being observed. In the latter case, however, it is considered that potash may be a major limiting factor, and it is the major

limiting factors which these observational trials are designed to detect. The actual amount of improvement brought about by any of the treatments can only be measured by trials of a more refined nature, and it is hoped, ultimately, that these will follow when the main regions of fertilizer responses have been mapped out.

In regard to the different potassic fertilizers available, 30 per cent. potash salt has given slightly better results than its equivalent in sulphate of potash or muriate of potash. Trials with varying quantities of the former have indicated an appreciable superiority of 2 cwt. per acre over 1 cwt., but applications of 3 cwt. per acre did not appear to be substantially better than 2 cwt. dressings.

Quality of Produce.

References to potash manuring promoting quality in the products of grassland are somewhat vague. In an experiment at Marton(11) Hudson and Doak reported that, while potash added to phosphatic and nitrogenous fertilizers had produced only a slight dry-weight increase, the potash content of the herbage from such plots was at all times higher than that from plots not receiving potash. These writers quote Woodman and Underwood(12), who state "there is no important reason for attempting to improve the potash content of the herbage by manurial treatment, since *untreated* herbage contains sufficient to supply the requirements of grazing animals." The function of potash in animal nutrition seems to be obscure, and, in regard to nutrition, it does not appear of very great moment whether the dry matter contains 2 per cent. or 3 per cent. of potash (K_2O).

In supplying potassic fertilizers the farmer is chiefly concerned with yield-increase, firstly of grass and secondly of the live-stock product, and there is quite a difference of opinion relative to the factors correlating yield of grass and yield of animal product.

Potash in the Soil.

Estimations of available potash in the first 3 in. of soil do not suggest any correlation between the figures so obtained and the potash responses. In point of fact, Bell(3) quotes analyses showing a Waihi soil, which was particularly responsive, as having an available K_2O content of 0·098 in the first 3 in. Numerous soil-samples from Taranaki could also be quoted to support the unreliability of soil analyses as a guide to manuring practice. There is a school of thought which supports "massive" applications of potash, or, in the words of Eckstein(13), "If a fertilizer experiment be laid down on a soil which tends to absorb potassium energetically, applications of potash may at first show no effect, not because the soil is rich in potash but because the degree of saturation of the soil colloids with respect to potassium is too low." Trials which have been laid down some years, but which in the earlier stages showed no appreciable responses to potash, commenced to give results last season. It will be interesting to see whether this is maintained in another year, in view of Eckstein's hypothesis, but, on the other hand, last season was a particularly wet one, and the high rainfall may have been a factor contributing to a spasmodic improvement.

Summary of Present Knowledge.

(1) The use of potash alone for top-dressing pastures has proved in the main to be ineffective. In isolated cases good results have been obtained, but, conversely, in a few specific instances detrimental effects have been recorded.

(2) Certain districts enumerated appear to be definitely responsive to top-dressing with potash in conjunction with phosphates, or phosphates and lime, and good results have been recorded in these localities. Such responses have been characterized by an increased content and vigour of clover in the sward. Thus white clover can be regarded as the index plant for soil-requirements of phosphates, lime, and potash.

(3) Evidence tends to show that the improvement of white-clover growth may be the main contributing factor in the increased palatability of the herbage which is often associated with such responses.

(4) Some of the best results have been obtained on pastures which had previously been cut for hay or silage frequently.

(5) Areas on which potash has been effective have several features in common: (*a*) They are generally subject to high rainfall; (*b*) the soils are mostly light in texture or have been well leached; (*c*) in general the soils derived from andesite and basalt show more consistent responses than do those derived from rhyolite.

In conclusion, it should be pointed out that most of the trials carried out so far have been qualitative only, and that it is hoped to carry out more comprehensive experiments on areas showing the major potash responses. Nevertheless, the observational trials carried out have indicated that in certain districts potash can definitely be recommended. The data from the more detailed experiments, together with the general survey of fertilizer responses and the soil survey which is at present being carried out by officers of the Geological Survey, probably will add greatly to our knowledge of fertilizer deficiencies and their alleviation.

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DEFICIENCIES KNOWN AND SUSPECTED IN LIVE-STOCK NUTRITION OF NEW ZEALAND.

THE PRESENT POSITION AND FUTURE WORK.

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NUMEROUS instances have been recorded in New Zealand in which domestic animals have failed to grow or to produce to their full capacity through the entire lack of or the reduction to a low level of some of the essential food factors required by the body. Deficiencies of iodine and phosphorus undoubtedly exist as such, while cobalt and iron deficiencies are as yet interrelated. Calcium and magnesium deficiencies may or may not exist, while protein deficiency is also to be considered only as a possibility. Vitamin deficiencies, particularly A and D, may exist in intensively fed stock such as pigs and poultry, but except in pigs are to-day relatively unimportant in New Zealand live-stock feeding.

IODINE.

A considerable amount of analysis of New Zealand food, water, and soils has been performed by Hercus and his co-workers. More recently Mason and Sykes, working in the Chemical Laboratory of the Department of Agriculture, have carried out extensive analyses of thyroid glands of lambs in an attempt to survey the iodine content of districts. Shore and Andrews have also added considerably to the knowledge of the position in certain parts of New Zealand. The survey is now well forward, and is being continued by the Department of Agriculture, with the result that the deficient areas of New Zealand are fairly well mapped out.

Iodine deficiency generally in New Zealand is not considered sufficiently widespread to cause hairlessness and mortality in young pigs, nor to interfere to any extent with the assimilation of calcium and phosphorus nor the production of milk. There are, however, to be seen cases of goitre in calves and lambs in districts known to be low in iodine and where salt-licks have not been provided. Such an example was reported at Wanaka by Dayus and others. Incipient goitre may also be noted in calves in deficient areas, as reported by Webster in North Taranaki. Provided that an iodized-salt lick is used in known deficient areas, there is no necessity to add potassium iodide to licks in a general way as fashion prompted some years ago.

So much critical work has been performed on endemic goitre as opposed to exophthalmic goitre that it is now practically an accepted fact that endemic goitre results from a deficiency of iodine in the food intake, or because of poor assimilation of the iodine present. That being so, all that remains for workers in New Zealand to do is to map clearly areas of shortage quantitatively so that the necessary iodized-salt licks or foods rich in iodine may be given to domestic animals in those areas. Such work belongs to the chemist and soil-survey officers, but correlation of this work with animal disease should also be considered.

PHOSPHORUS.

Phosphorus is the limiting factor in development of the skeleton, milk-production, and œstrum. There is usually a greater deficiency of phosphorus in the food intake than there is of calcium, but it is necessary to have some optimum balance between calcium and phosphorus to get the best results in production and reproduction.

There is considerable variation in calcium and phosphorus in New Zealand pastures. Where intensive dairying is carried out the pasture analysis shows that the richest pastures contain 1 part each of calcium and phosphorus in 100 parts of dried material. Where œstrum is failing, phosphorus has probably dropped to 0·2 per cent., while rickets and osteoporosis occur at slightly higher levels in growing animals. An excess of calcium can so bind phosphorus that the animal remains deficient even though the quantity of phosphorus with a lowered calcium would be sufficient for ordinary purposes of animal metabolism.

Bone-softening (osteomalacia) may be due to deficiency of vitamin D preventing assimilation of calcium and phosphorus as in pigs and dogs, to excess of phosphorus over calcium as in lambs on green oats, and in horses, or to deficiency of phosphorus alone, largely seen in herbivora. This latter is the more common. Phosphorus deficiency is New Zealand has always been common, and acute phosphorus deficiency was given the name "Waihi disease" in earlier days. Fragility of bone and lack of sufficient phosphorus in the soil and pasture led to medicinal treatment with iron phosphates and to soil top-dressing with bonedust, and later with superphosphate. Because of the habit of stock of chewing bones when phosphorus deficiency developed, green bone was given to cattle, and later steamed bone flour was given in salt as a lick. As bone flour contained calcium as well as phosphorus, the provision of a bone-flour lick was a rational form of treatment, and, where the soil itself could not be treated by top-dressing, still is a very useful method of giving phosphorus to stock. By its use many areas of New Zealand have increased their calf and lamb crop from 40 per cent. to 90 per cent. and over, and have very greatly increased the milk-yield of both ewes and cows.

The rational use of superphosphate as a means of increasing production is to be commended, but the use of enormous quantities of superphosphate alone on land already low in calcium is to be deplored, for it may easily defeat its own object and bring about deficiency of calcium in the body and cause stock ailment.

It can be assumed that almost any part of New Zealand not using some form of phosphatic top-dressing is deficient in phosphorus. That being so, it is advisable that stock-licks composed of bone flour and salt should at all times be provided for stock, and more particularly for dairy cows, the phosphorus excretion of which is so extraordinarily heavy.

Research work on phosphorus assimilation in stock is by no means finished, but the more important aspect is the finding of the correct balance between phosphorus and such other minerals as magnesium and calcium, and other food constituents such as protein. This latter aspect is one in which drought areas are more interested. Blood chemistry has become helpful in diagnosis, but still is full of pitfalls, while bone analysis of animals can be used to some extent to map out deficient areas.

Calcium.

As has been discussed already, calcium is largely bound up with phosphorus in animal metabolism, and it is advisable to maintain a reasonable balance between the two minerals. Rickets is frequently considered to be due to calcium deficiency, but Sir Arnold Theiler taught that the limiting factor can always be found to be phosphorus in bone troubles of stock. It would, however, be reasonable to assume that with low calcium and high phosphate, as in green oats, upon which growing lambs become bandy, the low calcium is as limiting a factor if not more so than the phosphorus. In such feeding the calcium is still further bound by the high phosphorus.

Although very little real proof exists, milk fever and bloat in dairy cows and sheep are believed by some workers to be due in part to the lack of balance of calcium and phosphorus. The hypocalcæmia which is present during the coma of milk fever is cured by addition of calcium to the blood-stream, and appears to be prevented by the addition of burnt lime to drinking-water or to soil prior to calving. It has also been noticed that an increase of lime to pastures has prevented bloat, but it is not possible to show by analysis of blood or bones of animals that there has been an actual shortage of calcium. The shortage may have been sufficient in the case of bloat, however, over a long period to produce a lack of tone in the alimentary system.

Much work could be performed in certain districts on the effect of lime in prevention of bloat and milk fever, taking into consideration the possible change in pasture-plants brought about by top-dressing and the chemical change in organs of the animals. The effect of deficiencies of calcium and magnesium on parathyroid of cattle and sheep and the detrimental effect of increases of phosphorus could very profitably be examined.

Magnesium.

In some of the particularly rich dairying districts of the North Island a condition in cows known as "grass staggers" occurs shortly after calving in the early spring. Investigation has shown that the blood is temporarily deficient in magnesium yet the total quantity of magnesium in the body has not been lowered. Analysis of pasture has shown no deficiency of magnesium, but there is usually a high phosphorus content and a tendency for a low calcium content. "Grass staggers," *post partum* paralysis, and milk fever seem to occur on the same farms, and it would appear that there is a lack of balance of phosphorus as against magnesium and calcium.

Trials of feeding of dolomite and magnesium sulphate in silage, licks, or drinking-water have been carried out fairly extensively, and one believes that by such methods of increasing the bodily content of magnesium that the animals can resist "grass staggers." It has been noted that there is a definite temporary drop of magnesium in the blood of animals placed on rich pasture after a winter feeding of hay and non-growing poor grass. Future work must be carried out to find the reason for this temporary drop of blood-magnesium, and such work would appear to be bound up with the practice of superphosphate top-dressing, or else with the use of selected strains of grasses.

Iron and Cobalt.

For many years Aston's theory of a definite iron deficiency being causative of anæmia in ruminants in certain areas of the North Island was rigidly adhered to and accepted as a reason for anæmia and death not only in New Zealand, but in other well-known areas of the world. Aston's finding and utilization of limonite as a commercial source of crude iron for preventing bush sickness was epoch-making. The fact that burnt limonite and limonite from other sources than the original were inert gave the clue to the possibility of other metals present in limonite in trace quantities being necessary for iron assimilation or for themselves alone. Already at this stage it was known in Florida that copper was required in conjunction with iron. Filmer and Underwood in Australia, finding that some other substance was contained in limonite, and that probably cobalt or nickel was the active material, led to work in South Australia by Marston and in New Zealand by Rigg and others at Cawthron, with the result that cobalt can now be used as a preventive in salt licks at the rate of 2 oz. to the ton of salt in certain South Island areas previously considered bush sick or nearly so. Similar work is about to be carried out in the North Island. Trace elements such as cobalt are found remarkably deficient in some areas of New Zealand, and cobalt is almost absent in many of the volcanic showers and in places such as Morton Mains. It would seem unnecessary to give iron as such in these known deficient areas, and to give in its stead a cobalt salt. Therefore, if that be so, one is not correct in speaking now of an iron deficiency.

The interaction of cobalt and iron in prophylaxis is not properly known, and whether cobalt acts as a direct blood-cell stimulant only or has some catalytic action on iron as well remains to be seen. Cobalt in excess will increase the number of reticulocytes and the hæmoglobin in blood, a fact which has recently been demonstrated in rats at Wallaceville. The work on this problem must be experimental on farms in affected areas, but it must be well controlled. Blood histology and chemistry is necessary to put the pathology of the disease on a proper footing. A continuation of soil survey, soil and pasture chemistry, and analysis of animal organs from experimental animals is also part of the research programme. Also production of anæmia in experimental feeding of cobalt-free diets would be of very great use. How a definite deficiency of cobalt or other minerals can exist without affecting animals such as horses, pigs, and rabbits is a matter for investigation.

Vitamins.

Vitamin deficiencies can exist only under conditions of poor husbandry, and are not dependent on deficiencies in soil and pasture to any extent, with the possible exception of vitamin A in drought seasons and in swine husbandry. They do not, therefore, come within the scope of this paper.

Protein.

Total-protein deficiency can exist on poor pastures, again mainly under drought conditions. Such a deficiency causes sarcophagia in animals, but with such favourable climatic conditions as exist in New Zealand one would scarcely expect to see evidence of lack of total

protein. There may, however, be a deficiency of certain amino-acids—that is, the food of stock may not be rich enough in complete proteins. This is considered to be a possibility in male infertility. It is known that high protein can cause male infertility in rat experimental work, and also that incomplete protein can also set up a similar testicular atrophy. The work on rats is at present being carried out on diets known to be incomplete in protein but complete in all other forms of food. Additional amino-acids are being fed with this basal diet. Considerable chemical assistance is required to list the amino-acid content of the pastures, animal organs, and experimental foods before this rat work will be completed. In turn the rat work has still to be repeated on domestic animals and so become translated into field practice.

USE OF PASTURES AND PASTURE-EQUIVALENTS IN PIG-KEEPING.

RECOMMENDATIONS OF THE MANAWATU-OROUA PIG RECORDING AND DEVELOPMENT CLUB.

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THERE are great variations in the degree of success with which pastures are being utilized in pig-keeping. These variations are due primarily to differences in the extent to which pasture utilization by pigs is based upon the following important facts.

The digestive organs and processes of pigs differ materially from those of other farm animals fed on pastures—e.g., *sheep and cattle.* From the digestive viewpoint cattle and sheep are much better fitted naturally to utilize much more bulky foods of low digestibility than are pigs. In the first place, cattle and sheep, but not pigs, are ruminating animals. In ruminating animals the food after being swallowed for the first time does not ordinarily reach the true digestive stomach until it has been first brought back to the mouth, where it undergoes a very thorough mastication or "chewing of the cud" which reduces it to a finely divided condition that facilitates the action of digestive juices. This in its turn enables the ruminants to digest more effectively than non-ruminants feeds of low digestibility, such as woody or stemmy crops—*e.g.*, pastures of rank or mature growth. In the second place, the alimentary canal in which digestion takes place is relatively much greater in cattle and sheep than it is in pigs.

The volumes of the alimentary canal in different animals computed from data given by Colin are—

	Volume of Alimentary Canal per 100 lb. of Live-weight. (In Pints.)
Cattle	50 to 60
Sheep	50 to 60
Pig	16 to 20

These figures, which obviously vary, depending on the size and condition of the animal, are in general agreement with those of other authorities.

The volume of the alimentary canal is of basic importance in feeding. Its function has been likened rather aptly to that of factory-space. Just as a large factory can handle more material than a small factory, so, in a similar way, an animal with an alimentary canal of large volume in comparison with its weight can utilize bulky supplies of feed better than can an animal having an alimentary canal of comparatively small volume. In this case feed is the raw material out of which flesh or milk is manufactured, and from the previous data it is clear that the cow and the sheep have spacious alimentary canals in comparison with the pig.

There are great differences, vital in pig-feeding, between the characteristics and feeding-values of pastures of leafy relatively short young growth and of ones of stemmy mature or rank growth. These differences are intensified when the latter pastures are characterized by the absence, or the markedly scant supply, of clovers, which are specially rich in proteins and mineral matter.

The comparative feeding-values of leafy growth of pastures and of stemmy growth may be gauged from the following facts: (1) The dry matter of samples of leafy pasture contains approximately twice as much phosphate and lime as the dry matter from corresponding herbage at the hay stage. (2) The dry matter of leafy pasturage contains approximately two and a half times as much protein as occurs at the hay stage. (3) About 80 per cent. of the dry matter of leafy pasturage is digestible, whereas only from 40 per cent. to 60 per cent. of the dry matter of stemmy growth is digestible.

The true significance of these three facts lies in the further fact that the rations of animals capable of a high rate of production, such as pigs, are apt to fall short of the full requirements in respect to their mineral and protein contents and their digestibility.

From this it follows that any system of pasture utilization which brings about rank herbage or which lessens the clover content of pastures is in those respects unsuitable in pig husbandry.

There are important differences between (a) *leafy growth of pastures, roots, and green crops and* (b) *skim-milk, whey, cereal grains and meals, and meal and fish meals.*

The position is indicated by the following table:—

Yield of Nutritive Material (expressed as Pounds of Starch Equivalent) from 100 lb. of Dry Matter.

	Lb.
Skim-milk	99
Whey	93
Maize	96
Peas	90
Barley	87
Meat-meal (containing a good deal of fat)	137
Leafy grass	70 to 80
Carrots	70
Swedes	66
Chou moellier	66
Coarse grass	40 to 50
Hay	30 to 45
Straws	15 to 25

This table shows that feeds can be grouped into three distinct classes—(i) Poorly digestible or bulky; (ii) readily digestible or non-bulky. Cereals, meals, and skim-milk belong chiefly to the latter, in which skim-milk is outstanding; while hay, straw, and coarse grass belong to the former. To obtain any given amount of nutriment the digestive apparatus of the animal has to deal with much more feed material (irrespective of its water content) in the case of the former than that of the latter, which therefore are more suited in general to the needs of animals with relatively small volume of alimentary canal. (iii) Leafy pasture-growth, root crops, and green fodders before they become woody are intermediate in character: in practice they serve as readily digestible non-bulky feeds when not fed in excess, or as poorly digestible bulky feeds when fed in large amounts.

Because of the limited capacity of the alimentary canal of the pig the difference between bulky and non-bulky feeds is of prime importance. Hence it is well to bear in mind that a feed which from the storage viewpoint is bulky is not necessarily bulky also from the nutritive viewpoint. Bulkiness in respect to nutrition is governed largely by the character of the dry matter: if a substantial amount of the dry matter is not readily digestible, as when the feed is woody or of high fibre content, then for nutritive purposes the feed is bulky, whereas if the dry matter is of high digestibility, as when its fibre content is low, then the feed is non-bulky. Hence, for practical purposes skim-milk, from which fibre is absent, is non-bulky, whereas hay or silage, with a fibre content of 25 per cent. to 35 per cent. of its dry matter, is bulky, and pasture-growth with a fibre content of 10 per cent. to 20 per cent. of its dry matter is of intermediate type. The bulkiness of the feed itself as distinct from its dry matter is of some moment, but the dominant consideration is the character of the dry matter as determined largely by its fibre content.

There is a close and inescapable connection between economy in feed-consumption and rapidity of growth. This may be illustrated by considering the feed requirements of a pig of 200 lb. live-weight. Such a pig requires for mere maintenance the equivalent of 3·6 lb. of meal daily and an additional 2 lb. of meal or its equivalent for each 1 lb. increase in live-weight. Hence, if such a pig is growing at the rate of 1 lb. daily a total of 5·6 lb. of meal or its equivalent is required to produce 1 lb. increase in live-weight, but if the pig is growing at the rate of only ½ lb. daily then 9·2 lb. of meal is required to obtain 1 lb. increase in live-weight. This means that in respect to production of flesh the effectiveness of the feed used at the slower rate of growth is only 60 per cent. of that of the feed consumed at the quicker rate of growth. Keeping this in mind, let us return to the use of bulky and non-bulky feeds. In growing animals the maintenance requirement is met first, only the balance over and above this requirement being available for production. If the pig, with its limited "factory" capacity, is fed on bulky feeds the nutriment available will be only little, if at all, in excess of the maintenance requirement: if the pig is given non-bulky feeds comparatively large amounts of nutriment will be available for

production. Hence, if it is desired to obtain growth at the maximum rate then easily digestible non-bulky feeds should be fed. Such easily digestible non-bulky feeds are often called "concentrates," the most important of which in New Zealand dairying are skim-milk (a diluted concentrate), cereals, and peas.

It follows from the facts just considered that in the interests of feed-economy concentrates such as skim-milk should be used as exclusively as possible in the production of flesh, and to enable this to be done less concentrated feeds, such as pasture-growth, root crops, and green forage crops, should be used mainly—and as much as possible to replace concentrates—for maintenance. The more such crops can be used for maintenance the greater is the amount of farm-produced concentrates available for flesh-production with a minimum of feed-consumption. This is the key to the judicious use of pastures and pasture-equivalents in pig-keeping as a subsidiary venture to dairying. In dairying the production of concentrates in the form of dairy by-products is distinctly and definitely limited; the provision of other concentrates, such as the grains of barley, maize, and peas, either by farm-production or by purchase, is costly in comparison with the provision of less concentrated feeds such as pasture-growth, root crops, and green crops.

Access to pastures or crops of similar nature is frequently valuable because of the exercise it provides and because of its influence upon the health of animals. This results from the freer provision of vitamins and of sunshine.

The pig, whether it be the sow with young or the growing animal, normally is capable of high and efficient production. One aspect of this is reflected in the computation that for 100 lb. of digestible nutrients consumed—(*a*) The pig produces 25 lb. of dressed carcass, equivalent to 15 lb. of edible dry meat; (*b*) the sheep and steer yield less than 10 lb. of dressed carcass, equivalent to only from $2\frac{1}{2}$ lb. to $3\frac{1}{4}$ lb. of edible dry meat.

But from data already discussed it is clear that such economical conversion of feed into meat is compatible only with feeding which allows the maximum rate of growth to be attained. This in its turn is incompatible with the free use of somewhat coarse feeds of relatively poor digestibility or the general toleration of any substantial "store" period in the case of animals being prepared for slaughter. The sow with young ranks with the rapidly growing pig in its high rate of production and in its need for a high standard of feeding. The position in respect to well-developed dry breeding-animals is somewhat different, rations slightly in excess of maintenance requirements normally being sufficient for these. Further, a "store" period in the case of animals being grown for slaughter is at times justified, when, for instance, the "store" period enables advantage to be taken later of a cheap concentrate as occurs when pigs are wintered as stores and finished off on dairy by-products in the spring, and when the alternative to the store period would be the use of concentrates, expensive in comparison with dairy by-products. In such cases the winter "store" period—*i.e.*, the period of relatively slow growth—involves the use mainly of farm-grown crops, which can be provided at a comparatively low cost.

Summary of Basic Principles of Successful Utilization of Pastures by Pigs.

To sum up, the successful utilization of pastures and kindred crops in the production of pig-meat as a subsidiary to dairying are based largely upon the following considerations :—

(1) The digestive organs of the pig are unfitted to utilize coarse bulky feeds effectively.

(2) Coarse swards containing but scant amounts of clovers are substantially inferior to the short leafy growth of well-balanced mixtures of grass and clover in respect to their digestibility and their content of flesh-forming substances and of mineral matter.

(3) To exploit the capacity of the pig for high production and rapid growth, highly digestible rations rich in minerals and flesh-forming substances must be provided as far as is compatible with costs and returns.

(4) Economy in feed-consumption is governed by rapidity of growth.

(5) While highly concentrated feeds such as skim-milk and cereals are desirable for rapid growth, less concentrated feeds serve well for maintenance.

(6) The less concentrated feeds as a rule are cheaper or more easily obtainable than the highly concentrated ones, the use of which should be confined as much as practicable to the pigs of highest production—*e.g.*, pigs for slaughter and sows with young.

(7) Irrespective of direct feed-economy, access to pastures and other crops of similar nutritive value is useful in respect to health and to exercise, which may affect carcass quality.

Practical Application of the Principles.

The application of these concepts in practice may be summarized as follows :—

(1) Pasture-utilization should be based upon *extensive* rather than upon *intensive* methods of grazing.

(2) Considerable use should be made of pastures for—

(*a*) Dry sows :

(*b*) Suckling sows with litters :

(*c*) Not as a rule for pigs definitely being fattened, for which, however, access to pastures at regular intervals should be provided. Especially, however, should young pigs have access to pastures and outdoor conditions for some time immediately after weaning :

(*d*) Store pigs only if fluctuations in the feed-supply make this advisable ; generally a store stage is undesirable.

(3) It is desirable to provide pasture-equivalents for use during periods of pasture-shortage ; crops which yield suitable equivalents, including lucerne, subterranean clover, broad red clover, Montgomery red clover, green cereals, and chou moellier and roots.

(4) Where practicable it is desirable to grow cereal crops or peas for grain, such crops because of their less bulk being valuable in conjunction with the pasture-equivalents.

Extensive versus Intensive Methods of Grazing.

Extensive methods of grazing may be practised by giving the pigs range over pastures of several acres the feed from which is consumed mainly by dairy cows. It contrasts with the intensive method of grazing, in which the pigs are confined to relatively small areas of grassland: one of the layouts which has been recommended commonly for this purpose provides for the subdivision of an area of 2 acres into ten small paddocks to which access is given by a central race and beyond which the pigs are not to be allowed to graze. It has been demonstrated that the intensive system, involving the use of only small paddocks, when operated with suitable equipment facilitates the convenient and systematic feeding of pigs; further, because of its open-air character and the grazing that it permits, it is definitely superior to a system under which pigs have little or no access to grassland. On the other hand, it has been found in practice to have certain substantial disadvantages apart from its cost, which is considerable.

In the first place over a wide range of conditions, in winter and early spring, when usually leafy feed is particularly needed, the small paddocks are "poached" or "pugged" or productive of comparatively little feed. In the second place, eventually, and indeed fairly soon, the feed in the small paddocks deteriorates greatly, becoming less wholesome and less attractive. This is due to unavoidable changes in the composition of the swards of the small paddocks, changes which necessarily arise from the enrichment of the soil due to the excreta of the pigs. The changes normally consist of clovers being suppressed and grasses becoming dominant and coarse. It becomes difficult, if not impracticable, to keep the resultant herbage short and leafy, and even if it is kept fairly short and leafy it may be expected to be relatively poor in mineral matter, which is believed to be of considerable moment in the nutrition of pigs. It would be much better to avoid, as far as possible, the undesirable change in the composition of pastures by having the animal manure from the pigs distributed as evenly as possible over, say, 12 acres to 20 acres instead of 2 acres—a result which is at least partially secured under extensive methods of grazing. Distributed over the larger area the manure leads to improvement, whereas concentrated on the smaller area it leads to deterioration of pasture.

Grazing by the extensive method is sometimes far from successful. To be successful the grazing must be arranged in such a way that the pigs receive not only highly nutritious feed—fresh, leafy, and satisfactorily rich in clover—but also ample amounts of such feed. In the winter especially pigs are often grazing on bare pastures. Poor results may be expected from pigs so grazing unless suitable supplementary feeding is carried out, just as the results are poor from cows grazing on bare pastures without suitable supplementary feeding.

Because of the highly profitable returns obtainable from well-fed pigs, and because good feeding of the pig calls for the provision of feeds of relatively high nutritive value and digestibility, there is no justification for management which gives the pig second

place to the dairy cow as is sometimes done by making pigs "followers" to cows on pastures. When this practice is adopted the cows naturally consume the choice leafy herbage, leaving the comparatively inferior stemmy herbage for the pigs, which are less fitted physiologically to use such herbage effectively than are dairy cows.

Against grazing by pigs on wide range by the extensive method it has been objected that damage to the pastures results from the rooting habit of pigs. It has been shown that danger of such damage can be removed by suitable "ringing" of the pigs. Another objection often raised to extensive grazing by pigs is that ordinary fencing is insufficient to keep pigs from roaming widely and even on to neighbouring farms. Experience shows that as a rule pigs do not pass through a seven-wire fence reasonably well made and maintained, but that fences in bad repair and poor feeding both beget wandering habits, which are not eradicated readily and which may lead to pigs going through even good fences. Further, areas of special crops usually can be secured without much effort or cost. A further objection raised to extensive grazing is that the pigs would be subject to tubercular infection from herbage contaminated by infected cows. Veterinary opinion is that generally any danger in this connection is small, that it is at least offset by the greater vitality with greater general resistance to disease which results from the more healthy conditions provided by extensive grazing, and hence that the expectation of disease in pigs on wide range is less than in confined pigs. A possible exception to this arises in the case of pigs grazing after cows suffering from tuberculosis of a type which leads to discharge of the tubercle on the herbage.

While as much extensive grazing as possible is advocated, it is not to be deduced from this that no small paddocks are desirable. As is indicated later, the use of small paddocks for particular purposes and particular circumstances is recommended. But because of the cost of providing small paddocks suitably equipped for the convenient watering and feeding of stock, and also because of the drawbacks to the small paddocks relative to grazing which have already been considered, the aim throughout should be to reduce the number of small paddocks as much as is possible having regard mainly to the beneficial influence a small amount of green feed, exercise, and open-air life may have upon the well-being of the pig.

Dry Sows on Pastures.

Great success has attended the grazing of sows between the weaning of one litter almost up to the farrowing of the following litter. When the pastures used for this purpose have been ones of high quality yielding leafy herbage sows have lived largely, if not wholly, on the pastures alone for long periods, and the subsequent results have been good. The mature sow can with safety live more completely upon pasture-growth than can the young developing sow, the requirements of which are greater to meet not only the needs of maintenance and pregnancy which are common to both mature and developing sows, but also those of growth. The feeding of sows on pastures in this manner is of great practical moment

because it increases the proportion of dairy by-products available as a concentrate or non-bulky feed for use in rapid flesh-production by pigs for slaughter. That quite a substantial amount of additional cheap concentrate may thereby be made available for rapid flesh-production may be gauged from the fact that the maintenance requirement of two pigs of 250 lb. live-weight has been estimated to be approximately equal to the maintenance requirement of a cow of 800 lb. live-weight.

Probably the feeding of breeding-sows extensively upon pastures of poor or badly balanced botanical composition or of stemmy over-mature growth would provide a deficient diet and result in poor litters. On the other hand, observation shows that, if no other factors intervene, good litters may be expected from sows grazing on pastures providing abundance of high-quality leafy herbage.

Sows with Litters on Pastures.

The essential difference between the grazing management of dry sows and that of sows with litters arises from the desirability of having full control of the litter. One way of securing this is the provision of a small paddock of grass to which there is access from the stationary farrowing-quarters. This small paddock probably is of more value as an open-air accommodation area than as a grazing-area from which nutriment is obtained. What is a suitable size for such a paddock varies with the nature of the soil—a smaller paddock suffices on well-drained soil. Paddocks ranging in size from about $\frac{1}{8}$ acre to $\frac{1}{5}$ acre are proving serviceable according to the conditions.

Such small "accommodation" paddocks should have direct access to larger paddocks for grazing by the extensive method when the litter is old enough to be allowed wide range—*i.e.*, after it is about four weeks old. Up to weaning, the sow with litter is fed and housed at the farrowing-house.

Store Pigs on Pastures.

The normal procedure, having due regard to feed-supplies and feed-costs, should be to eliminate a store stage by providing from weaning to slaughter stage rations which meet not only maintenance requirements, but also full production requirements. Such rations provide the essential basis for the rapid growth and consequent economy of feed which has already been discussed. However, as the result of seasonal fluctuations in the supply of cheap concentrates—*e.g.*, dairy by-products—it may become possible to supply such rations only in the form of farm-grown or purchased concentrates, and this at a cost which is not economic or maybe not so economically attractive as would be an alternative course. This alternative course consists in having the growing pigs pass through a store stage, during which they are fed largely on pastures or pasture-equivalents which provide a relatively cheap supply of feed. The wintering of store pigs which later utilize effectively the supplies of dairy by-products in the spring often is a useful application of this. For this purpose, when the supply of feed directly available

from pastures is inadequate, it often may be supplemented suitably by the use of one or more of several farm-grown crops, including mangels, carrots, swedes, pumpkins, chou moellier, temporary pastures, green cereals, and subterranean clover; and the use of limited amounts of concentrates—*e.g.*, grains of cereals, including maize, peas, meat-meal, and meals of similar nature—to supplement such crops is usually sound economically. Similarly, in the latter part of the summer, if the milk-production falls off at an abnormally rapid rate because of exceptionally dry conditions a store stage for growing pigs may become advisable, and then areas of lucerne and pastures rich in red clover are fitted to provide valuable yet cheap grazing. The best results from the grazing of store pigs are normally obtained from adoption of the extensive method of grazing, and the pigs may be accommodated in special inexpensive housing.

The Use of Grass for Pigs being fattened.

Recent investigations carried out at Massey Agricultural College and at Ruakura Farm of Instruction give results which are in agreement and which also are in general agreement with the results of similar overseas investigations. Further, these results confirm the experience of many successful farmers in indicating that little, if anything, is to be gained in regard to direct economy of feed from the grazing of pigs being prepared for slaughter. Hence the use of fattening-pens is advocated. It is considered advisable by some, however, that, in general, pigs being prepared for slaughter should not be confined continuously throughout the after-weaning period to the fattening-pens. Because of this each fattening-pen should have a companion small paddock of grass to which the pigs should be given access for relatively short periods at regular intervals. Farmers who adopt this practice consider that it fosters good health, and that in the case of pigs which tend to develop too much back-fat the practice minimizes or corrects this tendency. Some experimental work carried out in New Zealand supports this view.

The General Objective summarized.

Leafy pasture-growth, especially when not poor in clover, being intermediate in character between non-bulky and bulky classes of feeds, and being suitable for use as a non-bulky feed when not consumed in excess by pigs, may be made a very important and inexpensive part of the rations used in pig-keeping. On the other hand, coarse stemmy pasture-growth, being a bulky feed, has little if any value as part of the rations of pigs. Because of the fundamental difference between leafy and stemmy growth the basic purpose of pasture-utilization by pigs should be the provision of leafy growth. This means appropriate pasture-control, which in the case of grazing by the extensive method can be obtained readily by using cattle as the agents of control. In the case of the small paddocks prescribed for the use of sows with young litters and of fattening pigs it is difficult, if not impossible, to maintain suitable control of the pasture-growth by the grazing of pigs only, and it is usually advisable to resort to the mower and to other grazing-stock such as sheep and store cattle as aids to the control of the growth.

ADJUSTMENT OF SEASONAL FEED-SUPPLY TO SEASONAL REQUIREMENTS OF ANIMALS.

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BECAUSE of the differential growth of herbage plants throughout the year and because of weather hazards, the most difficult problem of the stock-raiser is the provision of an adequate supply of feed for every day in the year. Worthy efforts have been made to facilitate the provision of feed, generically grouped under the title of "making two blades of grass grow where only one grew previously," either by better strains of grass, by better methods of sowing, establishing, and managing, by top-dressing, or by other means. While on the whole these have been successful, there are those who have failed to get the best advantage from them, but have nevertheless been able to run stock successfully.

Before proceeding further it may be helpful to set out in tabular form the amount of pasture-growth each month and the feed requirements of different classes of stock each month as a percentage of the total for the year.

Table showing Monthly Production of Grass (Average, Maximum, and Minimum) and Monthly Feed Requirements of Stock—All Percentages of the Total for the Year.

Grass-growth.				Feed Requirements.				
Month.	Average.	Maximum.	Minimum.	Cow giving 300 lb. of Butterfat without Change of Live-weight.	Cow giving 200 lb. of Butterfat with Changes of Live-weight.	Ewe and her Lamb fat at End of Four Months.	Ewe and her Lamb fat at end of Seven Months.	
							No Change in Ewe Live-weight.	Change in Ewe Live-weight.
August ..	2	6	1	10·3	6·2	6·9	6·6	4·1
September ..	5	10	1	11·1	7·9	9·5	8·3	8·9
October ..	15	30	10	10·5	15·8	12·0	9·7	13·2
November ..	25	35	10	9·9	16·6	13·4	10·7	13·6
December ..	20	30	10	9·3	16·7	15·1	11·2	11·2
January ..	7	40	2	8·6	5·0	6·3	10·8	10·7
February ..	5	20	2	8·4	3·6	6·3	9·0	8·2
March ..	8	20	2	8·0	11·4	6·3	10·0	9·9
April ..	4	10	0	7·6	7·8	6·3	6·0	7·6
May ..	3	10	0	4·9	2·8	6·3	6·0	5·0
June ..	2	10	0	5·4	3·2	6·3	6·0	8·3
July ..	2	6	1	6·4	2·8	6·6	6·3	4·2

From the above table it is evident that the high-producing well-nourished animal that does not change in weight requires a distribution of feed that is defined within narrow limits, and subject, for a stated performance, to only slight variations due to warm dry or wet cold weather; that nature on the average provides a distribution of feed that makes no attempt to fit the animal's requirements, even if the average were dependable; and that the average distribution is widely departed from in every month of the year; finally, the animals that do change in weight thereby

change their feed requirements to fit the average pasture-growth, or, more accurately, that changes in pasture-growth cause the animal to adjust its weight accordingly, abundant pasture permits the storing of fat, short rations force the animal to use its body reserves and so to lose weight. In the process of feed adjustment this process might reasonably be placed first.

Using the Animal as a Storehouse.

There is probably no process more widely used nor any so indispensable as this in the feeding of stock. Without it drought conditions would destroy stock periodically in almost every part of the world—lazy or inexperienced stockmen would lose more stock than they reared. It is used efficiently and appropriately to combat short spells of insufficient feed, and on country where it is difficult or impossible to have other reserves, especially where the level of stock-production is low. It is used conveniently and less appropriately on paddock farms, where its mistaken costlessness presents it as an easy substitute for better ways of providing feed. Where animals lose weight they must regain it, and this they do when feed is abundant in spring. Three consequences result from this. First, production-feed that could be sold as fat-lamb carcasses or butterfat is stored as ewe body-weight or cow body-weight. Next, the animal storing weight and producing at the same time eats to stomach capacity, and may consume the spring surplus to such an extent that there is little left for putting by as reserves of hay. A repetition of the process in the following year is thus not prevented. Finally, where stock are hungry for long periods there is difficulty in maintaining good grass, and many of the failures of improved strains and of better methods of utilization are directly due to failure in making adequate feed provision for times of scarcity. On the whole the use of this process should be confined to cheap and natural conditions. Its elimination from conditions of artificial high production would mean the better exploitation of all processes of advanced husbandry.

The Production and Sale of Produce at and during the Peak of Pasture-production.

The natural increase by birth and maximum production of meat or other animal products are everywhere arranged to coincide with the peak of pasture-production. This usually coincides with spring and summer. The selling of butterfat and of fat lambs and all surplus stock by the beginning of early autumn are of similar import in adjusting feed-supply to stock numbers. Appreciation of the part played by the sale of finished produce has lead some stockowners to use the market extensively, wintering as few sheep as possible, stocking up to capacity in early spring, and selling everything that fattens when it is ready. As a national policy it is impossible for every one to pick the plums—if plums they be—in this way, and it is opposed to that stability of progress so essential in all stock projects. Where supplementary crops are grown excessively, the market has to be used excessively. It is probable that most lambs fattened after the end of March in the

South Island are bought lambs, and, since these represent about half of the killings for the South Island, this practice appears to be quite important—a link between the high country and the paddock farms. Whereas the high-country sellers are rightly using the markets to facilitate the adjustment of their feed-production, buyers of store lambs are actually doing the very opposite. They have created an abnormal feed-supply in autumn, and have to buy sheep to eat it. This has two direct consequences—(1) It reduces the area of grass and consequent summer capacity; (2) on most farms the fattening lambs use some grass that would otherwise be ewe-feed, and in so doing often cause shortages of ewe-feed, with consequent poor ability to produce in spring, punishment of grass that makes renewal necessary, and lambs of slow growth that require further supplementary crops.

Having Standing Reserves of Feed (Khaki-Grazing).

Next to the processes outlined above, this is probably one of the most important throughout the world. It is the wild animal's method of wintering, moving from higher to lower levels in winter and oppositely in summer. The nomad introduced some refinement in that he eliminated the factor of topography and grazed wherever suitable feed was to be found. Range grazing in Western United States of America and the grazing of fenced areas at special times in many places the world over are still further refinements. High-country grazing in New Zealand is not dissimilar to the natural grazing by the wild animal. Having standing reserves is the obvious cheap and efficient method of smoothing out the feed-supply under conditions of low production where the country is rough. Its cheapness and efficiency have established it in a modified form as a practice on most paddock farms. Its use here levels out the variations in growth due to variable rainfall, and when it is combined with suitable top-dressing it has been all-sufficient on farms of high-producing capacity. It lends itself to sheep more than to cattle. Sheep have a higher peak production in spring. The amount of spring surplus is therefore less, and not sufficiently generous to warrant its being saved as hay. Dairy cows, with a low peak requirement, leave a surplus that can be cut for hay. Again, sheep are virtually in store condition for six to seven months of the year, whereas cows are thus for three or four months only. Standing reserves may feed sheep adequately while they are not producing heavily, and so provide as much as half the animals' requirements for the year.

Measurements made at Lincoln College indicate the probability that paddocks shut up for three months and grazed at the end of this time provide as much store feed for sheep as they would have provided productive feed if grazed in the young-leaf stage. The selection of grasses that would hold their leaf long past maturity would appear to be a point worth considering where it is desirable to hold large quantities of khaki grazing in reserve.

Having Reserves as Hay or Silage, etc.

This is the time-honoured, positively organized method of saving the summer plenty for the periods of winter scarcity. It is a costly safe insurance by comparison with other methods, and a practice

that is steadily growing in New Zealand, the figures for grass, hay, and silage being as follows: 1920, 117,000 acres; 1927, 288,400 acres; 1934, 470,000 acres. The figures for the Auckland Province are even more striking—44,000, 91,000, and 180,000 acres for the years 1920, 1927, and 1934 respectively.

The making of hay is usually more popular on dairy-cow country than where sheep are raised, for the reasons already mentioned. It has no reactions or bad consequences resulting from it, and amongst the processes of adjusting feed-supplies it must be placed first as the most positive, orthodox, and organized of methods. Reserves amounting to 10 tons of hay, of chaff, or its equivalent per 100 ewes for 120 days feeding in winter is about the maximum that is kept, but even this provides only about half their requirements. One ton per cow would be a small amount, yet this should provide all the maintenance for 120 days' feeding.

The Growing of Supplementary Crops.

Like the saving of hay, this has come to be the recognized and widely accepted method of providing winter feed. Unlike hay, however, supplementary crops, while valuable for their costless-storage attribute, are not capable of being stored for more than a limited time. Again, whereas hay must be always more costly than the grass from which it grew, supplementary crops may be much cheaper than grass when yields are heavy, or they may be very much more costly when yields are light. They are especially grown with grain, or where hay is impossible, usually because of low rainfall. They are often grown for the convenience with which they fit into the grass-renewal practice, but sometimes their being grown too frequently becomes the prime cause of the renewal of grass. The growing of supplementary crops is closely associated with the buying and selling previously discussed.

The Use of Top-dressing.

The use of manures was traditionally associated with the production of harvested crops, and was applied to grassland most usually for the production of hay. Manure gives its peak of response about two to three months after application, and for hay-production it was rightly applied in August or September. These months are also the convenient times to apply it on most mixed farms, where team work is slack at this period of the year, and so top-dressing was thoughtlessly and wrongly done at this time of the year. Enlightened farmers appreciated that it often gave a flush of feed when there was already too much, and explored the possibilities of applying top-dressing in other months of the year. Top-dressing has its greatest value when it gives growth in the off-season, and where it is applied in December, January, February, or other non-spring months its proper function appears to be appreciated. If the year is divided into quarters it would appear from observations at Lincoln College that pasture-production is least variable and lowest in the quarter ending 30th September (7 per cent. to 10 per cent. of the year's growth takes place in this quarter). Top-dressing in any other quarter of the year, but more especially in the quarters ending April and July, consistently increases the September yield

up to 14 per cent. to 18 per cent. of the year's growth, and brings it within striking distance of the animal's feed requirements of 18 per cent. to 20 per cent. By top-dressing appropriately as regards time and amount and by the intelligent use of other factors some sheep-farmers in the South Island have profitably dispensed with the growing of supplementary crops. Good grass well sown and well managed is certainly the key to the maximum exploitation of top-dressing.

The Use of Different Kinds of Grass.

While few would dispute the excellence of rye-grass and clover of the perennial types as judged by abundance of yield under perfect management, there are some who recognize the importance of out-of-season grass and have taken steps to secure it. Many of the grasses that have failed to stand up to the hard treatment that is necessitated by occasional spells of dry weather are nevertheless capable of persistence when treated according to their merits, and those that produce out-of-season grass have, for this reason, come into prominence sporadically in many localities. Prairie-grass that disappears from pasture under ordinary conditions persists when grazed appropriately and grows so abundantly in late winter and early spring that some who use it can do without turnips. Canary-grass seems to have the same attributes. Subterranean clover, because of its winter-growing capacity, and because it is not eliminated by being eaten out in periods of dry weather, has advantages over even wild white clover in some localities. The growth habits of red clover, cocksfoot, and paspalum have long been appreciated, and the project of having more or less pure or dominant strains of these pasture-plants in small areas is becoming increasingly important. The development, because of their off-season productivity and the use of what was once considered inferior plants, has doubtless been stimulated by researches into grass-strains, and is destined to become of major importance in the immediate future. If grasses that grow abundantly in the off-season and that possess the property of " store ability " in the paddock to a high degree—usually associated with a coarse-leaved succulence—could be exploited and developed, a very useful work would be accomplished.

Using Different Kinds of Stock.

Whereas breeding-ewes and dairy cows have a well-defined feed-distribution for maximum production and react most sensitively to reduced supply, dry sheep and fattening cattle can tolerate fluctuations below the normal with less serious consequences. The day that the rams are put out with the ewes determines the week five months later when abundance of feed is required, and unless it is forthcoming—and a late spring is not unusual—then all the care that has been spent on ewes for the whole of the year may be easily undone.

With dry sheep or non-dairy cows a feed-shortage if protracted for an extra three weeks has less serious consequences than with in-lamb ewes, and the former class of animal appears to be an excellent safety-valve to guard against the vagaries of lack of feed in spring. Provided two light hoggets can return 10s. each by way

of wool and price increment for a year's feed, they are just as profitable as a ewe that produces a fat lamb at 20s., since her wool usually goes to offset her depreciation. Where hoggets are kept to replenish ewe flocks they cannot as a rule be used in this way. During the last four years in Canterbury ewe or wether hoggets were as profitable as ewes, but at the present it is difficult to see how they can be with higher winter buying-prices of hoggets and higher prices of fat lambs. There are fewer feed difficulties on a farm that carries 800 hoggets and 400 breeding-ewes than on a similar one carrying 800 breeding-ewes. Similarly, yearling cattle that show an improvement of £3 to £4 in value are as profitable as sheep, and almost as profitable as cows of 200 lb. of butterfat, and, if used as equalizers of feed-supply, they ease the feed position considerably.

Saving Seed.

Where use has been made of pedigree grass, carefully sown and well established, intelligently managed and top-dressed in relatively small areas where one grass is dominant, the saving of seed is a profitable adjunct to sheep-farming. It appears to have advantages over grain-growing as an association with sheep, because with this treatment grass is helped by the spells of seed-production. Grass is often looked upon as a second string in grain-growing districts, with little attention given to its permanence, establishment, or management.

Irrigation.

Irrigation removes the weather hazard from grass-growing and leaves only the hazard of temperature, thus extending the growing-season from perhaps four to eight or nine months. Where irrigation is a possibility, the perennial types of rye-grass and white clover must ultimately attain the fullest expression of their worth.

Grass-drying.

Grass-drying is of interest because of the certainty with which it establishes reserves of high-quality feed. It appears to have become established on a commercial basis in other countries, and to deserve careful attention in New Zealand. In association with irrigation, it should be exploitable to best advantage.

Conclusion.

The above considerations have been set out with the object of reviewing the processes commonly in use for adjusting the feed-supply to the needs of the animals. While these processes are often consciously used with skill to achieve the desired object, many use them automatically because it is the custom of the district, and without the skill that is associated with conscious effort. Some use them to their own embarrassment, being forced to make amends for the abuse of one by the wrong use of a second or other process. This is not to be wondered at. It was well illustrated in pigs some ten years ago, when the absence of an adequate winter-feed supplement to take the place of skim-milk forced pig-feeders into the malpractice of paying ridiculous prices in spring for weaners, which they fed to bacon-weights. Both high-priced

weaners and uneconomical feeding of a few were inimical to profits. So now with sheep: Excessive growing of supplementary crops in many places forces farmers to use the markets wrongly, to persevere with bad grass, and so to limit their summer carrying-capacity in a way that is inimical to profits. Finally, appreciation of this review might lead to better co-ordination of scientific effort. Grass is useful only as stock products, and better utilization of better grass by better stock must make more progress than will be made merely by spending all our efforts on better grass and ignoring the other factors. Consideration might even be given to what better grass really does mean, and to whether a selection of vigorous winter-growers with ability to persist by reseeding or other hunger-proof devices, and capacity to store themselves in the paddock in a succulent stage over long periods, may be a matter worthy of better consideration.

EFFECT OF ANNUAL APPLICATIONS OF SULPHATE OF AMMONIA AND SULPHATE OF POTASH ON YIELD OF A PHOSPHATED PASTURE.

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IN a paper presented last year to the Grassland Association Conference attention was directed to an apparent effect of sulphate of potash in overcoming the depression in yield that follows the repeated use of sulphate of ammonia and superphosphate on the pastures at the Marsden Research Farm, Stoke, Nelson. It is the purpose of this article to show how this effect has operated during the past four years.

SEASONAL PRODUCTION.

It will be necessary first to examine the distribution of the yield of dry matter over the season. In Table I data are presented showing the distribution of yield of dry matter for different treatments during the 1935–36 season.

Table I.

Period.	Yield in Pounds of Dry Matter per Acre.		
	3 cwt. Superphosphate.	3 cwt. Superphosphate, 1½ cwt. Sulphate of Ammonia.	3 cwt. Superphosphate, 1½ cwt. Sulphate of Ammonia, ½ cwt. Sulphate of Potash.
24/7/35 to 30/9/35 ..	686	872	907
1/10/35 to 23/12/35 ..	2,628	2,467	2,548
24/12/35 to 20/5/36 ..	2,527	2,453	2,677
Total	5,841	5,792	6,132

It is clear from these data that where nitrogen has been used markedly increased yields were obtained in the first, or early-spring, period, but that later in the season where nitrogen and phosphate only were used the yields fall below those for phosphate only, so that over the whole season the total yield in the former case may fall below that of the latter. On the other hand, when potash was added to the fertilizer treatment the depression in yield in the second period was not so great as for nitrogen in conjunction with phosphate, and in the third period the yield from the complete treatment was actually the highest of all the treatments. For the whole season the complete treatment of nitrogen, phosphate, and potash gave the highest yield. The increase in yield for the season of the complete treatment over that of nitrogen and phosphate has amounted to 340 lb. of dry matter per acre. This increase, together with that of 224 lb. for the third period, was statistically significant.

Now compare the yields for the phosphate and the complete treatments. Except for the initial period when the nitrogen was exerting its full effect, the complete treatment did not show a very marked advantage in yield over the phosphate treatment, the total increase of the second and third periods for the complete treatment being only 70 lb. of dry matter above the yield of the phosphate treatment.

It must be pointed out, however, that the use of potash has very largely overcome the depression in yield shown in the second period under nitrogen treatment, and in the third period the complete treatment shows a statistically significant increase over both the phosphate and the phosphate-plus-nitrogen treatment. It appears therefore that on this Nelson pasture in the presence of potash the depressing effect of annual applications of sulphate of ammonia on yield was not so marked, and that potash acted in the direction of making the distribution of production on the completely fertilized area approach more closely to that on which phosphate only has been used. This is important in Nelson, because any reduction in pasture-production during the summer period has a serious effect in limiting the carrying-capacity of a farm.

Examination of the yield data for the same three fertilizer treatments shown in Table I over the past four seasons yields some interesting results. The requisite data are given in Table II. It is clear from these data that the complete fertilizer has given the best result in terms of pounds of dry matter per acre in all four seasons. If allowance is made for the exceptionally dry season of 1933–34, the increases in yield shown in favour of the complete treatment were appreciable, and almost in proportion to the total yield of the corresponding season. Moreover, except in 1933–34, these increases were statistically significant.

But when a comparison is made of the yields from treatments A and B, it is seen that, except in the first season, decreases in yield, not statistically significant, however, have followed the annual use of sulphate of ammonia in conjunction with 3 cwt. superphosphate. The use of sulphate of ammonia usually on this pasture does not appear to be advisable, even though annual phosphate applications are also provided.

Table II.—Yield in Pounds of Dry Matter per Acre.

Season.	Treatment A.	Treatment B.	Difference B–A.	Treatment C.	Difference C–A.
1932–33	3,869	4,006	137	4,077	208
1933–34	3,192	3,119	73*	3,265	73
1934–35	4,830	4,828	2*	5,052	222
1935–36	5,841	5,792	49*	6,132	291

* Decrease in yield.

NOTE.—Treatment A: 3 cwt. superphosphate per acre; Treatment B: As A plus 1½ cwt. sulphate of ammonia; Treatment C: As B plus ½ cwt. sulphate of potash.

To obtain the direct effect of the potash application, the differences in yield of treatments B and C must be taken. These are given below in Table III:—

Table III.

Season.	Pounds of Dry Matter per Acre: Increase following Use of ½ cwt. Sulphate of Potash per Acre.
1932–33	71
1933–34	146
1934–35	224
1935–36	340

SUMMARY OF RESULTS.

These data indicate that potash when used in conjunction with a manurial programme involving the annual use of superphosphate and sulphate of ammonia was having an increasing beneficial effect on the pasture, as the increments have increased to a much greater extent than would be expected from the annual totals. As these increases have been obtained in seasons of varying moisture conditions, it would appear that potash has maintained the pasture in a better state of productivity than would have been the case if nitrogen and phosphate only were used for top-dressing purposes. Not only has the use of potash enabled the depressing effect of sulphate of ammonia to be overcome, but, as indicated in Table II, the complete treatment has given materially improved yields over the use of superphosphate alone. This does not mean, however, that the use of a complete fertilizer will be profitable. Indeed, the data indicate that, compared with the cost of 3 cwt. of superphosphate per acre, the complete treatment cannot be payable. But the data show the value of potash applications in promoting an optimum yield of pasture in those cases where sulphate of ammonia is used frequently in addition to a top-dressing of superphosphate.

SUMMARY.

The use of a complete fertilizer gave the highest yield of pasture in mowing-trials at the Marsden Research Farm, Stoke, Nelson.

The use of sulphate of potash at the rate of ½ cwt. per acre overcame the depression in yield following the annual use of sulphate of ammonia on a phosphated pasture.

Where nitrogen is used annually in conjunction with phosphate, application of potash appears to be necessary if optimum yields are to be obtained.

VINE-CULTURE UNDER GLASS.

(Continued.)

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THE STONING-PERIOD.

THE young berries swell very rapidly for several weeks, and then for three or four weeks almost stand still. The berries at this time look very hard, and the cuticle has a tough appearance. This is the stoning-period. During this time the day temperature should be kept down as much as possible by free top-ventilation. The object sought should be to secure as little difference as possible between day and night temperature. No attempt should be made to force the berries to swell, either by feeding the border or syringing the vines. This is the period when attacks of mildew and sun-scald are most likely to occur through wrong treatment, and also it is the time when mildew can do most damage. Opening of the bottom ventilators while there is any condensed moisture on the berries or the leaves must be carefully avoided. The berries swell rapidly again as soon as stoning is completed, this stage being known as the second swelling. When this begins, syringing may be taken up again, and the border may be given liquid manure or water according to its requirements.

THE SECOND SWELLING AND COLOURING.

Thinning the berries, as far as possible, should be completed in one operation. This, however, is only accomplished by those who are experienced in the work and know what the vines they are working on are capable of producing, as well as the size of the berry to expect on different varieties. At least twice as many berries must be removed from Gros Colman as from Black Hamburg. Inexperienced people usually underthin, with the result that the berries soon crush together, rendering a second thinning necessary. In a ripe bunch the berries should touch each other without crushing. A bunch when cut and placed on a dish should retain its shape. If the berries crowd together, and the bunches have a stiff unyielding appearance when the second swelling begins, more berries should be taken out, or the bunches will be spoiled. The thinning should be completed before stoning is complete, but it is better late than not at all.

Soon after the second swelling begins the skin of the berries assumes a different appearance: it seems more transparent, a sign that ripening has commenced. The greatest increase in size is made during this period, swelling continuing until colouring is nearly finished. On this account the border should not be allowed

to become dry. Watering, when necessary, may be freely done until the berries are half-coloured. By the time stoning is complete and the second swelling commences the condition of the whole vine changes: the laterals become woody and the leaves firm. If the conditions in the house are reasonably dry, as they should be, there will be no further danger from mildew. Bottom-ventilation can now be applied. During fine weather what is termed a buoyant atmosphere should be maintained—that is, the air should not be too dry. "Damping-down" may be necessary, but some houses do not require it. Syringing the vines, which at this period is useful in keeping red spider under control, does not injure the bloom on the berries, though it is commonly said to do so: syringing may be continued till colouring is well advanced.

If during the ripening-period any great amount of foliage is removed, it causes a check in the developing fruit. This emphasizes the necessity for timely attention to "stopping" or checking the surplus growth before it has developed to a wasteful extent. Judicious "stopping" fosters the main leaves, which are of the greatest importance, and allows of a free passage for air through the vines. A good canopy of foliage above the fruit is required, but the leaves should not be crowded. If through neglect there is at this time more lateral growth than is advisable, such growth should be left till the grapes are ripe before cutting it out. In the meantime the points of the laterals should be "pinched off" to prevent them advancing further.

The After-ripening Period.

The after-ripening period is an anxious time to many growers of Gros Colman because the berries of this variety often crack badly. It is not an uncommon experience to lose the greater part of the crop from this cause. Madresfield Court, a muscat variety, is subject to the same trouble. This variety, however, is not extensively grown in New Zealand. The skin of the berry of these two varieties is different from that of others in that it is very porous and able to absorb a considerable amount of water. Thus, when the atmosphere of the house is surcharged with moisture, as may occur during wet weather, the berries absorb so much water that, the skin being unable to stretch sufficiently, ruptures are caused. The remedy is to prevent, by judicious ventilation, a still atmosphere about the berries. Some amount of top-ventilation should always be provided by night as well as by day; bottom-ventilation should be given all day, and the doors opened in the warmer parts of New Zealand. An additional reason for a proper control of lateral growths is here provided, for if the foliage is crowded the difficulty of maintaining movement of the air is greatly increased.

These conditions of ventilation are also suitable for keeping grapes of other varieties after they are ripe. Absolutely dry conditions should be avoided, or the berries will not remain plump. In a very dry house a little "damping-down" is advisable. In this matter, however, treatment right in one place may be wrong in another: every house should be treated in accordance with its condition.

Some growers think late lateral growth should be allowed to run free. Such a course tends to keep the vines active too long. This growth should be checked and the vines encouraged to rest as early as possible. The resting-period is very short in this country under the most favourable conditions.

Manuring Established Vines.

The manurial requirements of grape-vines are practically the same as those of most other fruit-trees, but as the vines are planted closely together, resulting in the soil being heavily taxed, manuring must be on a much more liberal scale than in the case of orchard trees. The principal substances necessary are phosphates, potash, nitrogen, and lime. In the case of grape-vines, where liberal quantities are used, it is necessary to be careful that some of the manures are not used in excess.

Lime is of great importance: instances of bad setting and of stoneless berries have been traced to a deficiency of lime. Potash is also of great importance. The most useful artificial potassic fertilizer for vines is sulphate of potash. Animal manures contain some potash, and wood ashes a considerable amount, which, however, is variable. Common artificial phosphates are bonedust and superphosphate; the former is generally preferred for vines. The principal nitrogenous fertilizers in use in New Zealand are nitrate of soda and sulphate of ammonia, both of which are of quick action, though the influence of the latter is likely to be more extended.

Stable manure is considered a complete fertilizer. Its content of potash is somewhat low, and it may contain only a small amount of nitrogen. It is a mistake to apply heavy quantities to the borders; this results in souring the soil, and cases are known where vines have been killed through heavy quantities being used. Good crops have been grown without the addition of other fertilizer when moderate quantities of stable manure have been applied to soils containing sufficient lime. Better results can usually be secured, however, by supplementing stable manure with artificial manures. Cow-manure has been used with good results where the soil is light and warm. It should be used with caution on borders with heavy soil.

The growth of vines in different soils and circumstances varies greatly in character. Where growth is very strong very little nitrogen, if any, is required in the fertilizer, while if growth is weak, or comparatively so, somewhat heavy dressing of nitrogen, preferably in the form of nitrate of soda, may be advisable. The role of nitrogen is to promote vegetative growth: it does this only when a sufficiency of the other elements is present. Care should be taken to avoid the use of too much nitrogenous manures, which is liable to retard the ripening of the grapes.

Briefly, the manuring procedure suitable for general use is: After the vines have been pruned the border should be cleaned up. If a summer mulch has been applied any residual strawy debris should be removed. If weeds are present they should be cleared away. The surface of the border should not be dug, using the term in its ordinary sense, but it may be lightly pointed over with

a fork. If the soil is in need of lime, a dressing of 2 lb. of air-slaked quicklime per square yard should be mixed well with the surface soil. If lime has been applied not more than two years previously, ½ lb. per square yard is sufficient, while, if given regularly every year, 4 oz. per square yard is enough. A month or three weeks before the vines are expected to start new growth a fertilizer, consisting of 2 oz. bonedust, 1 oz. sulphate of potash, and 1 oz. sulphate of ammonia per square yard should be applied and scratched in with a sharp-toothed rake. Just before the vines begin to flower, nitrate of soda, 1 oz. per square yard, should be applied, and later, when the grapes begin to colour, 2 oz. per square yard of sulphate of potash should be applied by being watered in.

Prior to the setting of the berries the surface of the border should be open to the sun. On the other hand, if some protection against sun and wind is not provided during summer the surface soil becomes dried, causing the roots to go more deeply in search of moisture, which is very undesirable. Therefore, when the berries have set, a mulch, about 6 in. thick of rather fresh and littery stable manure should be applied. The fertilizing substances in the manure are washed into the soil by the rain or by watering, and no other fertilizer is needed. If stable manure is not available a dressing consisting of sulphate of potash (1 part) and blood and bone (2 parts) may be applied at the rate of 1 lb. to 2 square yards. With this a mulch of some kind should be provided: this may be spent hops, straw, or any suitable material that is available. Pumpkins or marrows make an excellent mulch when grown from hillocks outside the borders and led over them.

Watering.

The grape-vine is a vigorous plant, and is expected to carry a fairly heavy crop of soft fruit which contains a good deal of water. If the vines are flourishing the border becomes full of roots, and a liberal supply of water must be assured. Outside borders rarely require watering till the stoning-period is past, and with inside borders watering should be of a minimum character during the stoning-period. It is after this time that the demand for water is greatest. When it is applied it should be in volume sufficient to penetrate the whole of the border. There is no danger of over-watering provided drainage is good. If drainage is not good, it is a defect that should be remedied the following winter. A thorough watering twice a week is sufficient for dry situations. It is a matter for which no hard-and-fast rule can be laid down: each grower must be guided by local conditions. Applications of liquid manure are advisable when the vines lack vigour. These should follow the watering.

Varieties.

The appended list is confined to those varieties which already are in cultivation under glass in this country, which have given general satisfaction, and which can be most strongly recommended. It is not suggested that other varieties are not worth growing, but it is claimed that the varieties mentioned supply all needs. The greater part of commercial crops consists of two varieties—Black

Hamburgh and Gros Colman. In some cases, where the vinery is close to a large population, the crop is mostly disposed of direct to customers. In these instances it seems to pay to grow varieties of superior flavour, which, though not producing so heavy a crop, command a higher price, and, further, serve to popularize the establishment. Muscat Hamburgh, Mrs. Pince, and Muscat of Alexandria are among the best that can be grown for this purpose.

BLACK VARIETIES.

Black Hamburgh.—This is the most popular and most widely grown of all varieties under glass. It does well in any form in which grapes are grown—in a cool or a warm house. Bunches and berries are handsome, and flavour excellent. It is to be understood that cultivation, regulation of the crop by thinning to the capacity of the vine, and general management influence the finish, consequent appearance, and flavour of the berries.

Gros Colman.—A thick-skinned vinous grape; berries very large and round. Flavour rather poor when first ripe; after hanging it becomes vinous and agreeable. In this country Gros Colman is the most extensively grown variety for late use.

Gros Maroc.—A very handsome grape when well grown. Berries ovate, very large, pleasantly flavoured, and vinous. Ripens soon after Black Hamburgh, and succeeds under the same conditions.

Madresfield Court.—A muscat, with handsome bunches; large berries of rich flavour. Is liable to crack and to lose colour. Requires similar treatment to that given to the Gros Colman. (See under "The After-ripening Period.")

Muscat Hamburgh (synonym Snow's Muscat).—An oval-berried muscat with rich flavour. Does well grown with Black Hamburgh; ripens soon after that variety. Does not hang long after it is ripe. Vineries should include a rod or two of this excellent variety grafted on 34 E. stock, which controls its tendency to "shank," and improves both crop and fruit.

Mrs. Pince.—A high-class late muscat. Berries medium size, oval or oblong. Skin thick and tough; flesh firm, crackling, vinous, and rich, with a fine muscat flavour. An excellent keeper, though apt to shrivel and lose colour. Requires a warm house in the cooler districts.

WHITE VARIETIES.

Golden Chasselas (Salomon's Selection).—Also known as Royal Muscadine. Flesh juicy, sweet, and firm, growth vigorous and hardy. Ripens early and hangs well.

Foster's Seedling.—A very free bearer of first-class quality grapes. Ripens with the Black Hamburgh.

Muscat of Alexandria.—Late; considered to be the finest-flavoured of all grapes. The oval berries should be golden-amber when ripe. Requires a warm house, but does fairly well in unheated houses in the warmer districts: 420 A. is a good stock for this variety in phylloxera-infested areas.

Pearson's Golden Queen.—A vinous grape; berries above medium size, oval; bunches handsome. A good variety that does well in most places. Season late; hangs well.

(To be concluded.)

CLOVERS IN CANTERBURY PASTURES.

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CROPPING and cultivation under warm and moist conditions leads to a rapid depletion of the organic matter in the soil. In the cropping-areas of Canterbury the depletion of organic matter is of major importance, often responsible for the poor establishment of pastures and the low carrying-capacity of them as well as low yields of crops. Those who have tried to establish pastures on cropped-out lands—*i.e.*, land whose organic matter has been depleted by a period of cropping and its associate cultivation—know how true this is. The fertility of our soils was a heritage of the past, and it is one of the functions of the farmer to maintain or build up the fertility. This can be achieved by adding organic matter in the form of farmyard manure, ploughing in green manure or growing crops including pasture, which are fed off on the field. The organic matter thus added to the soil, whether in the form of plant residue or stock droppings, provides the material for available nitrogen and the nitrogen increases the growth of grasses. The effect of this nitrogen can be seen in the vicinity of stock droppings and urine patches. This is more conspicuous in pastures on cropped-out land and in pastures deficient in clovers. In pastures without clovers such patches do not indicate an increase of nitrogen on the field, but rather a concentration of it. Legumes, however, build up the nitrogen content of the soil either through their residues or through dung and urine of grazing animals. Recent work with legumes has shown that the nodules also excrete nitrogenous compounds in the soil, and these compounds may be directly available to associate plants. An experiment by I. D. Blair has proved interesting in this respect. Rye-grass tillers from a single plant were planted in pots filled with sand washed free of nitrogen. Some were grown with white clover inoculated with nodule bacteria, others with white clover the seed of which was surface-sterilized and not inoculated. They received a nutrient solution minus nitrogen. Others were grown without the clover association and received a nutrient solution containing sodium nitrate, or sulphate of ammonia. The clover-seed was sown in the same pots two months before the rye-grass tillers were planted to allow the clover-plants to become well established and nodule bacteria to function. The development of the rye-grass after fifteen weeks (May 14th to September 1st) under these different treatments is shown in the following table :—

Table showing the Development of Rye-grass growing in Nitrogen-free Medium and treated with (a) Nutrient Solution containing Nitrogen, or (b) Nutrient Solution minus Nitrogen but growing with Inoculated or Non-inoculated White Clover.

—	A (Nitrogen).		B (Minus Nitrogen).		
	$NaNO_3$.	Sulphate.	Inoculated White Clover.	Non-inoculated White Clover.	Control.
Number of rye-grass tillers	134·0	188·0	142·0	7	50
Number of plants ..	20·0	20·0	5·0	5 (2 dead)	5 (all dead)
Average number of tillers per plant	6·7	9·4	8·4	1·4	..

This experiment indicates that white clover is capable of supplying nitrogen in an available form to rye-grass growing in association with it, and suggests the importance of establishing clovers in pastures as early as possible. Nitrogen is made available in the soil for grass-growth from at least two important sources: (*a*) the organic matter—this does not increase the nitrogen-content of the soil unless it be from leguminous crops; and (*b*) direct from growing legumes. The available nitrogen encourages vigorous grass-growth, and this when fed off adds to the organic matter in the soil, and the fertility of the soil is built up.

Calculations of the amount of nitrogen added to the soil by clovers in pastures have been made, and the amount varies with the clover and the soil conditions. In working with subterranean clover at the Waite Institute in South Australia, it was found the two successive crops of two tons each, if grazed, enriched the soil by approximately 108 lb. of nitrogen, equivalent to 5½ cwt. of sulphate of ammonia. Think of this on our light land or on cropped-out fields. Nitrogen free of cost (or probably at the cost of annual dressings of superphosphate and lime); extra grass-growth; extra stock grazed; extra organic matter; extra fertility. There is naturally a limit to the improvement that can be made in the fertility by these means, but on some of the cropping lands of Canterbury that limit is worth aiming at.

The general benefits of clovers in pastures are well recognized, and the majority of the mixtures sown contain clovers; but how many on the cropping-lands of Canterbury are satisfied with the amount of clover that comes from the sowings, particularly in the first few years in the life of a pasture?

Factors influencing Clover Content of Pastures.

The first requirement is to sow the seed. This may appear to be an unnecessary statement, but it refers to white clover. Many pastures are sown without white clover, not because farmers do not appreciate the value of white clover, but because they have sown white clover and it has not established, or they have observed white clover coming into their pastures in the third or fourth years. They are content to rely on the so-called natural white clover in the land or that brought in by sheep. There is no doubt that there are areas where the land contains white-clover seed and this seed is likely to establish in a pasture, but there are thousands of acres on the plains where reliance on such natural clover results in a clover-deficient pasture. The value of establishing clover in the first year has been mentioned, and one can have a reasonable chance of achieving this object only by sowing the seed. This, in itself, however, is not sufficient, and the other factors which influence the growth of clovers must be considered also.

The strain of clover sown has an important bearing on the clover content of the pasture. In the case of white clover the certified strains of New Zealand wild white clover have proved their own superiority for long-duration pastures over the ordinary commercial lines. In the case of red clover, it is well known that this valuable summer and autumn grower lasts only two years or so on the medium to light lands. The Montgomery red clover is a more persistent strain, and, while there are not many stands of this clover on the medium to light soils, the indications are that it will last one or two years longer on this class of land than the ordinary commercial red clovers, and is well worth

including in mixtures on such land. In regard to subterranean clover, from observations on some of the Australian strains and on the field establishment of some of the commercial lines it appears that strains more suitable for particular conditions can be isolated.

A third factor of importance is lime. Soils without sufficient lime are usually sour, and sour soils do not grow clovers. A number of common weeds grow well on sour soils, particularly sorrel and spurry. It needs only a trip through Canterbury in summer-time to see the thousands of acres of red flowering sorrel which bear evidence to the sour condition on many areas. A certain degree of lime-deficiency does not necessarily restrict the growth of grasses and cereals, and the application of lime has not resulted in marked response to the growth of these plants in many areas in Canterbury, with the result that liming has not been widely adopted in Canterbury (8,000 tons in 1933–34, compared with 60,000 tons for Southland). But on most soils in Canterbury a marked clover response is obtained. It is from this aspect that the liming must be considered. We must grow clovers in our pastures, and in order to achieve this object economically we must add lime. On pasture-lands up to 1 ton per acre can be put on as a foundation dressing. At Lincoln a pasture mixture was sown in December in a field half of which had been limed twelve years ago at the rate of 2 tons of carbonate of lime per acre. The mixture consisted of 25 lb. of perennial rye-grass, 7 lb. of cocksfoot, 3 lb. of red clover, 2 lb. of wild white clover an acre, and 1 cwt. of superphosphate an acre is applied to the pasture in the autumn. In the first three years the effect of the lime on the grasses was not noticeable, but the effect on the clovers was striking—both on red and white. An analysis of the pasture in the second autumn—*i.e.*, when the pasture was fifteen months old—is given in the following table:—

Table showing the Effect of Lime applied Twelve Years previously on the Establishment of Clover sown in a Mixture.

	Pasture Fifteen Months Old.	
	Lime.	No Lime.
	Per Cent.	Per Cent.
Rye-grass	60	90
Cooksfoot	5	5
Red Clover	20	4
White Clover	15	1

To-day (July, 1936) there is little clover on the unlimed half, and the grass is winter-burnt and fibrous-looking, while on the limed half there is a good mixture of clovers and the grass is green and luscious. When sheep are turned on the plots they graze the clover sward in preference to that without clover. This trial demonstrates the lasting effect of a heavy initial dressing of lime under Canterbury conditions.

The time of sowing also influences the amount of clover in our pastures. Clover seedlings are frost-tender. In the second- and third-leaf stage they are subject to frost-lift, particularly when the ground is wet, and therefore the seed should be sown early enough for the

plants to become well established before the heavy frosts set in. Nearly all our clovers are sown with rye-grass, which is a vigorous grower in its early life and may soon form a smother to retard the development of the associate clovers. When sown by itself clover will establish well on a good seed-bed as late as the end of March, but when sown with rye-grass as late as this the rye-grass establishes well, but the vigorous rye-grass retards the development of the clover, which is then subject to frost-lift. In a monthly sowing trial conducted at Lincoln a mixture of rye-grass, cocksfoot, and red and white clovers was sown at the beginning of each month from October to April. In the following autumn counts were made of the number of red-clover plants in each sowing, and the results are given in the following table :—

Table showing the Effects of Time of Sowing on the Establishment of Red Clover when sown with Rye-grass.

Date of Sowing.	Average Number of Red-clover Plants per Square Yard.
October–December	63
January–February	16
March–April	2

Now, many of our pastures in Canterbury are sown in March after a cereal crop, and it is suggested that this late sowing is frequently one of the major factors responsible for paucity of clover in the pastures, although the rye-grass may establish perfectly well even though sown as late as May. The ability of the rye-grass to establish in the late autumn often disguises the poor establishment of the clovers, and it is not until the second autumn that the absence of clovers is noticed.

Once having got clover established in the pasture by a combination of the factors mentioned—sowing the seed, sowing the right kind of clover, liming the ground, and sowing early—the amount of clover, particularly white clover, may be influenced by the grazing and manurial treatment. The clover is a poor winter grower, and starts growth later in the spring than does rye-grass. When the pasture is spelled in winter and early spring the rye-grass gets a start on the clover and suppresses it to some extent. Conversely, when pastures are grazed closely in winter and early spring, the close grazing prevents a dense rye-grass smother and gives the white clover a chance to develop, and may even allow too much clover to develop. Some of our pastures are subject to this treatment, especially where supplementary crops are a failure or not available. When the close grazing in early spring is associated with liming and autumn top-dressing with superphosphate, too much clover may develop. Farmers who get too much clover are indeed fortunate. They have the fertility building element. They can now proceed to reduce the amount of clover by encouraging the growth of grass by spelling in early spring and by applying soluble nitrogenous fertilizers. But, with the permanent strains of rye-grass and with intelligent manuring and grazing-management, too much clover will not be a common complaint in Canterbury pastures.

PASTURES AND PIG-FATTENING.

P. W. SMALLFIELD, Fields Superintendent, Auckland.

AT the 1935 meeting of the New Zealand Grassland Association McMeekan read a paper on the nutritive value of pastures in pig-raising, and, in respect to fattening pigs, stated that grass "is not capable of materially reducing the total requirements of other food except under a low plane of feeding, the successful practice of which is dependent on economic considerations": he gave details of two feeding trials which showed that "no measurable amount of nutriment was derived from pasture by the pigs in these trials, no significant difference either in growth-rate or in economy of food-consumption being apparent."

During the 1935–36 season a trial of a similar nature was conducted at the Ruakura Farm of Instruction, Hamilton, and a comparison made between baconers fattened in a sty and baconers fattened in cow pastures. The results were as follows:—

(1) *Growth-rate:* Pigs grazed on cow pastures showed a daily increase in dressed weight of 0·88 lb. and the sty pigs 0·89 lb.

(In McMeekan's experiment quoted above "grass" pigs showed a daily increase in dressed weight of 0·75 lb., and "no grass" pigs 0·76 lb.)

(2) *Economy of Food-consumption:* Pigs grazed on pastures required 564·5 gallons of separated milk per 100 lb. gain in dressed flesh and sty pigs 561 gallons separated milk.

(In McMeekan's experiment quoted above "grass" pigs required 533 gallons of separated milk and 18 lb. pollard per 100 lb. gain in dressed flesh, and "no grass" pigs 515 gallons of separated milk and 17 lb. pollard. In comparing the above trials it is to be noted that McMeekan's trials started with pigs of 40 lb. live-weight at the beginning and ended with pigs of 200 lb. live-weight. The Ruakura trials started with pigs of 73 lb. live-weight and ended with pigs 180 lb. live-weight.)

The information available shows that grass does not supply much actual food for fattening pigs; the same is probably true of special grazing crops such as lucerne, red clover, and white clover. The dairy-farmer's problem is to provide farm-grown food when grass is short: when there is plenty of grass there is plenty of milk and when there is no grass there is no milk. His problem is to balance the supplies of pigs for fattening to supplies of separated milk—no easy matter, as can be seen by the production of bacon pigs instead of porkers. Generally it is an actual shortage of pigs that induces the farmer to carry on pigs to bacon weights rather than waste separated milk. Although many farmers consider that the wintering of pigs is unprofitable, it is frequently found that the most successful pig-farmers do winter pigs—wintering them on farm-produced feeds. Connell(1) has stated that the farmers in the Manawatu district who are securing the most satisfactory returns from pig-meat production are those who make considerable use of

farm-grown feeds other than dairy by-products. He suggests the production of special crops for pig-feeding — mangels, carrots, swedes, barley, and field peas. Investigations in Auckland show that the most profitable returns from pigs are secured on dairy-farms in the Bay of Plenty where maize is grown. If provision is made for wintering, pigs need never be sold in a store condition: selling unfinished pigs in the autumn and buying stores or weaners in the spring does not lead to profitable pig-keeping.

The actual provision of root and grain crops for pigs on dairy-farms is not a simple matter. The tendency is to all-grass farming, and, with good pastures, all-grass dairy-farming is quite profitable. The problem appears to be to find a suitable grain or cash crop that can be grown in rotation with roots and green crops for supplementary feeding—a crop that will bring in sufficient money to pay for all the cropping. In South Island rotational farming the cereals provide the cash that allows of the production of turnips and rape for fat-lamb raising. In the Bay of Plenty maize for sale and for pig-feeding allows of the cheap production of swedes for the winter feeding of the dairy herd; in South Auckland the production of early potatoes allows of the cheap production of mangels and carrots for the same purpose; in the Manawatu peas and barley do likewise. Until adequate provision is made for the autumn and winter feeding of pigs, any further investigation of the value of grass, lucerne, or red clover as a supplement to separated milk hardly appears to be warranted.

REFERENCE.

(1) R. P. CONNELL: "Special Crops for Use in Pig-keeping," *N.Z. Jour. of Agric.*, April, 1936.

TYPES FOUND IN COMMERCIAL CRESTED DOGSTAIL.

W. A. JACQUES, Massey Agricultural College, Palmerston North.

IN crested dogstail there is a great variety in the type of plant which goes to make up any sample. Similar variations occur in other plants and have been recorded. It is intended to record here briefly the variations that occur in dogstail to bring it into line with plants that have been more intensely studied.

This variation in growth-form is observed between different lines, but the variation within any of the New Zealand commercial lines is greater than that between the averages of the lines themselves. There is variation in leafiness, earliness, shape of inflorescence, persistence, and, probably, root development. The variability from plant to plant is so great that one has difficulty in finding two similar plants among thousands of spaced plants from the same line. The type, then, as we see it in mass, represents an intermediate point somewhere between the extremes of the different characters. What we are accustomed to consider a feature of any one sample under observation is merely an accumulation of various features associated together to give a superficial resemblance to

that character. It is only when these plants are studied singly and the points of each analysed that we get a true conception of the extent of variability of any one character. From such an approach it is easily seen that modification of environment, be it climatic, biotic, or cultural, can bring about a profound change in the centre point of the observable characters by causing a modification in the incidence of the various forms, even without any actual structural change having occurred in the plants themselves. Thus has been brought about the variation in the lines of dogstail from different countries. The complexity of environmental factors acting on the mass is responsible for the differences observed and described. It is of interest to connect the climatic and cultural conditions affecting the types when considering the characters of each. The types dealt with below are—(1) New Zealand commercial, (2) Irish commercial, (3) roadside and permanent pasture, (4) selections from New Zealand commercial, (5) Kentish, (6) Scotch, (7) Dutch.

New Zealand Commercial.—This type represents the extreme for quick development from seed and earliness of growth. The growth (when seeds are autumn-sown) in the first autumn, winter, and spring is good, but there early develops a stemminess so that palatability falls away soon after active spring growth commences. When the plants are allowed to develop seed-heads, the check to growth is great and summer production is practically at a standstill. There is little activity until after the autumn rains unless the soil is moist, when production may continue through the hot period. Winter growth is rather better than that of Kentish lines. This is the first of the types to flower.

Irish Commercial.—The Irish samples tried out here follow the New Zealand commercial lines very closely in type. This is not to be wondered at, as much New Zealand commercial seed has been sown in Ireland for seed-production purposes and is harvested in a similar way.

Roadside and Permanent Pasture.—Seed was collected from various roadsides and pastures where dogstail was growing strongly and was well represented in the sward. Such seed germinated more slowly, the resulting plants were somewhat more leafy, but later in starting growth in the spring than the commercial samples. When once established, however, they outyielded the commercial types fairly considerably by the end of the first year, and gave a better winter production. They flowered from three to seven days later than the commercial lines.

Table I.—Yield: Seed sown April, 1933.

Origin.	October, 1933.	December, 1933.	May, 1934.
Commercial	100	100	100
Roadside and permanent pastures ..	90	108	146

Selections from New Zealand Commercial Lines.—Where selection has been carried out with a view to increasing permanence and leafiness, the end point shows little or no improvement over the

roadside and permanent pasture plants. It would appear that there is a certain amount of selection going on in the permanent swards, and that as a consequence the very early flowering types are not well represented. This group flowered from two to six days after the commercial controls.

Kentish.—Here a big change in type is noted. The seeds are much slower to establish, and in consequence the autumn and early-spring growth-rates (when autumn-sown) are much below that of the commercial lines. Growth proceeds longer into the early summer, and the Kentish permanent-pasture lines were from seven to ten days later in flowering than the controls (New Zealand commercial). Their rate of autumn growth, combined with their close crown and abundance of fine narrow leaves, gives them a better appearance than the controls in April. By mid-winter and at the commencement of the active spring growth, the rate of growth of established plants is somewhat below that of the controls. These English lines are undoubtedly more persistent and leafy than the New Zealand commercial ones, but slower in growth.

Scotch.—Only two samples have been tried out, and these proved to be similar in type to the Kentish.

Dutch.—In respect of time of growth and growth characters, the Kentish lines can be regarded as only intermediate between New Zealand commercial and Dutch. The Dutch lines represent the extreme for slow growth from seed and lateness of spring production, there being a difference of fourteen days between the appearance of flower-heads of the earliest New Zealand commercial and the latest of the Dutch lines. Their winter production, too, is the lowest of the types tried out.

A Consideration of the Variations described.

The New Zealand types (1, 2, 3, 4) can be grouped together when considering the cause of the development of their specific characters. It seems very probable that when dogstail was first introduced into this country it was of the Kentish or Dutch type. Certain ecological factors began to work, and a distinct type is now present in roadside and permanent pastures from the original introduction. The types which were most suited to the environment came to be represented in greater numbers, so that although there are doubtless most of the original variants present, yet there has been a shifting of the centre of the aggregate of the observable characters. Owing to the greater competition from quickly growing grasses in this country, the smaller, slowly growing, fine-leafed, longer-lived strains have been at a disadvantage. Consequently a stemmy, broad-leaved, early-producing type has predominated which, incidentally, is not very persistent.

In addition to this natural move towards a less leafy but early strain, the method of harvesting the seed which was current until recently has helped to accentuate this character still further. Stapledon, Davies, and others have frequently shown that commercial lines of grasses tested at Aberystwyth and elsewhere have invariably developed parallel tendencies.

For some years dogstail-seed in New Zealand has been harvested from one year and sometimes two year leas. The seed was autumn-sown, and in the following summer a seed crop was taken. Seldom was it left down for two years, owing to the fact that the yield of seed in the second year was poor and weed-growth became unduly strong. This in itself is, as we know, a retrograde step as far as pasture-seed production is concerned. In addition, however, New Zealand got an illicit fame for the brightness of her dogstail-seed. It was definitely favoured on the English market at the expense of the darker local and other imported lines. It generally has been considered by farmer and seedsman alike that a bright seed-sample denoted good harvest weather. The fact is, however, that dogstail ripens best where dull and even damp weather prevails at harvest, and in this respect is the complete reverse of rye-grass. What it really denotes is immaturity, as the best seed is a rich medium brown colour. Stapledon, when he visited New Zealand in 1928, notes this and wrote: "The association of brightness with presumed excellence is indeed a striking example of one of those seed characteristics which have come to have a trade value for no good reason and without the backing of any reliable tests or evidence for its justification."

In an endeavour to get such a sample it was necessary to harvest on the early side; thus the leafy, slower-growing, late producers were unable to ripen the bulk of their seed in time to be included in the seed harvest, and became more scarce. The selections from New Zealand commercial, roadside and permanent pasture plants can be classed as representing more or less the indigenous type. There is no doubt that they are more productive and rather later-flowering than the commercial strains. The type of artificial selection that has been carried on to increase leafiness and permanence in commercial lines has its parallel in the natural selection that is taking place in the field, and lies mainly in the direction of discouraging the very early producers, and consequently increasing the proportion of late producers. Thus one would expect an improvement of type by reversion to the stripper for harvesting the seed where, in the main, seed from the late producers is obtained while seed from the early producers tends to be omitted rather than increased.

The harder winters experienced in England engenders more noticeable falling-away of growth during winter-time. As no premium has been placed on earliness of growth (as has been shown to occur with New Zealand commercial samples) the type is later in developing both from seed and in spring. On account of this fact also, it persists better into the summer. The character of earliness appears to be linked with a broad leaf and stemmy growth as opposed to the narrow and more leafy habit of the later-flowering plants. It is possible to draw a parallel between Kentish wild white clover with its slower growth and finer leaf and New Zealand white clover with its more vigorous habits and larger leaf.

Dutch.—This represents the extreme opposite of the New Zealand commercial. The differences displayed by Kentish are still further

emphasized here. Winter growth is poor, and for a short period in mid-summer it is as productive as any of the others, but for the remainder of the year growth is less than the other lines. The harder the winter conditions the plants have to withstand the smaller is the annual production, but, treating the lines as a whole, the slower the growth the more leafy the plants are. This type from Holland, though excellent in many respects, is too slow in growth to warrant its extended use in this country.

RECENT REGULATIONS AFFECTING FARMERS.

AGRICULTURE (EMERGENCY POWERS) ACT, 1934.

THE Dairy Factory Supply Regulations, 1936, which came into force on 25th September, confer on the Executive Commission of Agriculture all necessary powers to carry into effect as far as possible by voluntary negotiation with dairy-factory companies concerned certain recommendations contained in the report of the Dairy Industry Commission on its investigation into the dairy industry in 1934 and relating to cancellation of cream-receiving depots in certain circumstances, the elimination of competition for supplies of milk or cream, and the minimizing of overlapping in the collection of supplies by the zoning of suppliers, by defining collection routes, by arranging for the amalgamation of companies, and by encouraging the making of boundary agreements between companies.

If the Commission is satisfied after full investigation that any creamery or creameries established in any particular locality is or are adequate and suitable for the manufacture into butter of all the cream produced in that locality, the Commission may direct that from a specified date all such cream should be weighed, graded, and tested only at the creamery wherein the cream is to be so manufactured, and that the registration and license of all cream-receiving depots in the locality should be cancelled. Upon cancellation it shall not be lawful for any person to receive or accept at any such depot cream intended for manufacture into butter.

The Commission is empowered to define and assign to the owner of any specified creamery any area or route from or along which cream produced in such area or along or adjacent to such route may be collected or received by such owner for the purpose of being manufactured into butter; to assign any such area or route or portion of such area or route to the owners of two or more creameries subject to such conditions as the Commission may consider reasonable; to fix a date upon which any such definition and assignment shall take effect and to give notice thereof to the owners of all manufacturing dairies thereby affected. After the date on which the definition and assignment of any area or route or portion thereof takes effect, it shall not be lawful for the owner of any creamery to whom notice of such definition has been given to collect or receive any cream produced in such area or portion thereof or along or adjacent to such route or portion thereof except with the written consent of the Commission and subject to such conditions as the Commission may impose. The Commission is similarly empowered to define and assign with the like consequences any area from which all whole milk produced therein may be delivered to and accepted by the owner of any specified manufacturing dairy for the purpose of being subjected to any process of manufacture other than treatment for sale for human consumption as liquid milk or cream, or to assign any such area or any portion thereof to the owners of two or more such manufacturing dairies subject to such conditions as the Commission may consider reasonable.

When by reason of the exercise by the Commission of the power to define areas and routes a co-operative dairy company is not permitted to continue to receive milk or cream from any shareholder supplier, the company, at the request of the supplier, must, unless the Commission otherwise directs, resume all shares held by him to the number necessary to qualify for the milk or cream supplied during the last season of supply and pay the supplier the amount of capital paid up on such shares. Where moneys have been advanced to any supplier by the owner of any manufacturing dairy on terms of repayment with interest by way of deductions from moneys payable by the owner of the dairy for milk or cream supplied, and where as a result of any determination of the Commission the milk or cream from that supplier must be delivered to or collected by the owner of another manufacturing dairy, then the latter owner, if he does not contract with the former owner for an assignment of the right to receive payment of such advance and interest thereon, must make such deductions as may be agreed upon by the parties from moneys payable by the latter owner to such supplier and pay the amount of the deductions so made to the former owner. If any dispute or difference shall arise as to the amount of the deductions to be made the matter shall be settled by arbitration in the manner prescribed by the Arbitration Act, 1908.

As a condition of exercising its powers the Commission may fix and award to the owner of any manufacturing dairy that the Commission considers will be prejudicially affected by the exercise by it of such powers such sum by way of compensation as it thinks fit or as may be agreed upon, and may specify the owner or owners of the manufacturing dairy or dairies that the Commission considers will be benefited thereby by whom the amount so awarded shall be paid and the portion to be paid by each owner if there are more than one. The Commission may make such stipulations and conditions as to the time, method, and terms of payment as it may think reasonable, and the amount of compensation so awarded shall be recoverable as a debt.

Nothing in the regulations affects the right of any supplier to supply either whole milk or cream to any manufacturing dairy, but in the exercise of his option the supplier shall not transfer his supply except in conformity with the provisions of any Act or regulations governing the transfer of supplies. The period of restriction on the transfer of supply imposed by the Dairy Suppliers Regulations, 1936, in cases where a purchase or merger of factory companies is effected, or where a boundary agreement respecting supplies is made between factory companies during any manufacturing season, has, however, been extended to the end of the manufacturing season following a period of three years from the date of such purchase, merger, or agreement, or from the date of any order or determination of the Commission made under the regulations. In consequence, the Dairy Suppliers Regulations, 1936, are revoked.

As incidental to the due exercise of the powers conferred by the regulations, the Commission is authorized on its own motion or on application made to it to revoke, modify, amend, or vary any order, determination, notice, or other act made, given, or done by it pursuant to the regulations, and in any inquiry that it may undertake in pursuance of the regulations the Commission may associate with it in an advisory capacity one or more members of the New Zealand Dairy Board.

The Primary Products Marketing Act, 1936.

The Dairy-produce Export Prices Order, 1936, made under section 20 of the above Act, carries into effect the several public announcements that have been made with regard to the prices to be paid for butter and cheese acquired by the Crown pursuant to Part II of the Act, being butter and cheese manufactured from milk or cream delivered to a dairy factory on or after 1st August and exported from the Dominion on or before 31st July,

1937. In addition to the fixation of differential prices according to kind, grade, and quality of the dairy-produce, the appropriate price payable for butter is varied to authorize payment of 3d. per box less for butter packed in the Saranac box, the thickness of timber of which is less than $\frac{3}{8}$ in., $\frac{1}{4}$d. per pound more for unsalted butter manufactured in quantities at the request of the Primary Products Marketing Department, and $\frac{9}{32}$d. per pound more for unsalted butter so manufactured if wrapped in aluminium foil of the prescribed thickness and backed on both sides with genuine vegetable parchment paper of the prescribed weight. In the case of cheese, payment is authorized of an additional sum of 6d. per crate for commercial standard-coloured cheese, 1s. 5d. per crate for deep-coloured cheese manufactured in quantities at the request of the Department, and $4\frac{1}{2}$d. per crate for waxed cheese where the quantity of wax used on each cheese does not exceed 4 oz. The question whether any cheese has been so coloured or waxed as to earn the additional premium shall be determined by the Grader, whose decision shall be accepted by all parties as final. Authority is also given to make a deduction of an amount per box of butter or crate of cheese to cover the portion of the insurance premium payable on such produce prior to shipment pursuant to a contract of insurance over the produce whilst in the process of manufacture or in transit. The method of computing the weight of butter and cheese for the purposes of payment is set out in detail, and follows the established practice in the trade in past seasons as incorporated in f.o.b. contracts. The price to be paid for butter or cheese which with the approval or at the request of the Department is manufactured, prepared, or packed for export in special containers or in special quantities, or in any other special manner, shall be the appropriate price fixed by the order increased by the additional cost incurred in such special manufacture, preparation, or packing as approved by the Department.

Stock Act, 1908.

By the Stock (Johne's Disease) Regulations, 1936, which came into force on 11th September, an Inspector under the Stock Act is empowered, where he is satisfied or has reasonable grounds for suspecting that Johne's disease exists among cattle on any land, to make arrangements with the owner for an inspection and examination of his cattle, such examination to include the application of the Johnin test. If any animal reacts to the test its destruction may be ordered, and if destroyed the owner will be entitled to compensation in terms of the Act. The regulations also make provision for regulating the shipment of dairy cattle from the North Island to the South Island. No dairy cattle shall be shipped to the South Island except in pursuance of a permit granted by an Inspector after such cattle have been examined and tested by a Government Veterinarian and found to be free from disease. Application for permission to ship any dairy cattle must be made in the first instance to the Inspector of Stock for the district in which the cattle are depastured, and if on examination any animal reacts to the Johnin or other test its destruction may be ordered, and, if destroyed, compensation for such destruction will be payable. If on examination the cattle are found to be free from disease, a permit in the prescribed form authorizing shipment will be issued.

—A. E. Morrison, Solicitor, Department of Agriculture, Wellington.

The Instructor in Agriculture at Timaru reports that a farm at Kingsdown has a field half sown in oats last spring, and half later sown in rape. A pasture mixture was broadcast over the whole area at time of sowing rape. On the oat ground the only take consists of rib-grass and catsear. On the rape portion quite a good sole of grass shows.

BERRY-FRUIT CULTURE.

THERE has been a marked increase in the quantity produced and the realizations obtained for all classes of berry-fruits. This increase may result in a more extensive planting of these classes of fruit. The following come within the scope of the public taste—viz., strawberry, raspberry, gooseberry, loganberry, and red, white, and black currants.

Production is at present confined to specifically defined areas; more especially does this apply to raspberries and currants. Climatic and environmental factors are responsible for this. Given favourable conditions of both soil and climate, proximity to a large centre of population, and a supply of pickers at the harvesting period, any one with limited means could embark on the production of one or more of these fruits in a small way, at first, and then extend the area under berry-fruits as the demand increased. The ease of propagating any of the varieties of the berry-fruits beforementioned is such that further extension of area can be brought about with little extra expense.

Whilst the chief demand to-day for these fruits is for jam-making, either factory or home manufacture, the quantity used for dessert purposes is relatively small. A more recent development, the demand for fruit-juices, opens up a much wider field, and it is possible that business of some magnitude in this direction may eventuate. The manufacture of fruit-juices is of some economic importance to the grower, inasmuch as it may obviate the risk of market gluts, and losses which occur through the quick ripening or the hold-up in picking due to unfavourable weather conditions.

—*H. F. Frost, Orchard Instructor, Masterton.*

Mammitis.—Speaking generally, the incidence of this disease has not increased during the year. Evidence of increasing confidence in the adoption of hygienic methods of control in the milking-shed is observed amongst dairy-farmers. The number of farmers who continue to avail themselves of the service provided by the Wallaceville Laboratory and the subsidiary laboratory at Hamilton, in the regular examination of milk-samples in the mammitis-control scheme, is an indication of appreciation of its application. The present-day outlook on this disease is more reassuring for those who take the trouble to adopt definite control practice. In the absence of any recognized curative properties in vaccination, hygienic control methods must be looked upon as affording a large degree of protection. The disease, however, is one which fully justifies intensive research.—*Annual Report, Director, Live-stock Division.*

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THE FARM.

Forage Cropping of General Importance.

A FAIRLY common mode of reasoning is exemplified in the following statement: During the past ten years or so Mr. X has changed from a sick to a strong man; during that period Mr. X has consumed no milk or eggs, therefore milk and eggs are of no value in promoting strength. This serves to illustrate the fact that correct conclusions are not always drawn from correct information. Of this same fact farming provides an illustration which is of interest at present. On certain farms during the past ten years or so production has increased greatly, cost of production has decreased appreciably, and during the same period there has been a decrease in the amount of special forage cropping carried out on these farms. From these facts it has been concluded that forage cropping should not be carried out. From these facts such a conclusion is quite unjustified. There may, of course, be other facts which justify the conclusion, but the facts given certainly do not do so, although they seem to be the facts upon which some come to a decision. Just as eggs and milk may have made Mr. X still stronger, so additional special forage cropping may make certain efficient farms still more efficient.

The special-forage-crop position warrants consideration largely because of the success which has attended such practices as top-dressing, silage, and systematic grazing. Recent years have been marked by increased knowledge of and better application of our increased knowledge in regard to grassland, and it is highly desirable that our efficiency in respect to grassland be not only maintained, but also improved. To recognize the value of other crops which give assistance in grass-farming is in no way inconsistent with an appreciation of the truly dominant role of pastures in our farming. Top-dressing, suitably controlled grazing, ensilage, all are of great proved value, but to obtain the greatest possible benefit from them it frequently is necessary to adopt other practices such as special forage cropping—in short, there are several links in the chain of factors which, acting together, tend to beget the fullest efficiency.

Special Forage Crops not always Advisable.

While the forage cropping of the Dominion profitably could be increased greatly, it needs to be kept in mind that it may not be advisable at times to grow special forage crops to supplement the pastures; some farmers work under disabilities, and these disabilities may be such as to make the growing of special forage crops of doubtful value. In the main, these disabilities relate to one or more of the following matters: Soil in respect to either its texture or its surface, weed-invasion, and, occasionally, but not as often as seems generally to be believed, labour. For instance, all of a farmer's land may be so heavy in texture and so poorly drained that he has no assurance of being able to provide a satisfactory seed-bed at the time when it is required for success. To take the other extreme, the soil may be so sandy as to be subject to the danger or erosion of "blowing" during windy weather. Again, in a few unfortunate districts the Californian thistle may be so strongly entrenched as to make ordinary forage cropping inadvisable. And, again, some farms are so broken in surface as to be without suitable arable areas. These may be taken as typical of the main disabilities which at times rule out the economic success of arable forage crops. Fortunately these disabilities are not of such frequent occurrence as casual

consideration may seem to indicate; for instance, adequate areas eminently suitable for special cropping are often to be found on farms consisting chiefly of either very sandy soils subject to blowing or heavy poorly drained soils. That good farmers working under disabilities relative to arable cropping realize that they are handicapped at times is rather well illustrated by the instances in which they obtain, sometimes with considerable difficulty, areas suitable for arable cropping to be used as one farming-unit in conjunction with their properties on which arable cropping is so difficult as to be impracticable.

An Alternative to Arable Cropping—Ensilage and Haymaking.

An important matter that requires careful consideration is the possible alternative to arable cropping consisting in the conservation of enough silage and hay from permanent pastures to suffice for the needs of stock during seasons in which the feed directly available from permanent pastures is inadequate. Undoubtedly on some farms this alternative course is preferable. Indeed, one may go to the extent of saying that on some farms arable cropping, haymaking, and ensilage all may quite well be ruled out because of the particular circumstances.

Certain aspects of a well carried out all-grass programme, including ensilage and haymaking, are of considerable practical importance. Incidentally, but a very small proportion of farmers carry out well the all-grass programme even in the districts in which it probably would be of the greatest value. This apparently is due primarily to the fact that its practically general application in any farming community is not altogether easy under the present organization of farming. On this point an examination of the position in a particular district certainly suggests that the general adoption of an all-grass programme well carried out would necessitate some substantial changes in the position relative to farm labour, assuming the present supply of labour on farms is efficiently employed in the summer under current practice.

A summary of the Auckland position may be given thus: For its dairy needs alone Auckland, under an all-grass programme, should harvest at lease 1,000,000 acres of hay and silage annually. Against this is to be set the fact that the present areas of hay and silage harvested for all the needs of Auckland annually is about 250,000 acres, and in this connection it is to be noted that, in addition to one million dairy cows, Auckland supports about three-quarters of a million other cattle and two and three-quarter millions of sheep, to both of which some special feed might be fed with advantage. That Auckland should save 1,000,000 acres annually for dairying under an all-grass programme is based on the following considerations: Customarily about 52 per cent. of the whole year's production of permanent pasture occurs in the three months October, November, and December, whereas only about 30 per cent. of the feed-consumption in dairying takes place in the same period. Hence, to deal with the surplus feed, about half the total dairying acreage would need to be utilized for hay or silage during the same three months. The total dairying acreage is about 2,000,000 acres—there are a million cows for which provision has to be made, and it takes about 2 acres to support a cow. Possibly the utilization of labour-saving equipment and practices would to a large extent enable the area of hay and silage to be increased four-fold, but practical experience on this seems somewhat scant.

Apart from any possible difficulty in respect to labour, a matter of some moment is that silage and hay of the sort usually saved is not suitable for all purposes for which special crops are of value. For instance, silage ordinarily is too fibrous to serve effectively as an alternative to soft turnips and crops of somewhat similar nutritive character for dairy cows in summer. Likewise, silage is not suitable as an alternative to roots, peas, and cereal grains for use by pigs during periods when dairy by-products

and leafy pasture-growth are in short supply. Just whether silage of a less fibrous nature should be saved more generally seems as yet not to have been established.

Another matter deserving of some attention is that the adoption of the all-grass programme tends to eliminate the direct improvement of pastures by the traditional procedure of ploughing up poor swards, growing special forage crops, and eventual renewal of the pastures. The growing of special forage crops is not a necessary intermediate step between the breaking-up and the renewal of pastures; indeed, at times it may be advantageous to omit it as an intermediate step. But, in general, some judicious forage cropping between the breaking-up of poor pastures and their replacement by good ones has been for many years, and is to-day, associated with much successful farming. Against this it may be stated that in the hands of some men and in some circumstances success has not attended forage cropping. But similarly in the hands of some farmers and in some circumstances success has not attended phosphatic top-dressing, a fact which certainly does not disprove the general advisability of phosphatic top-dressing.

From the preceding summary of the position the question that arises naturally is "How in practice can one distinguish between farms on which an all-grass programme is advisable and ones on which it is not advisable?"

This question cannot be answered satisfactorily in a way which would give information always applicable on individual farms. Knowledge of the circumstances on the farm is necessary as the basis of a reliable answer relative to a specific farm. But some general guidance is provided in the following facts:—

In the first place, generally it will prove definitely advisable to use the plough and to grow special crops such as mangels, turnips, and cereals whenever substantial improvement of some of the pastures on the farm could be obtained by ploughing them down and eventually resowing a permanent pasture. The development during the last decade, under official seed-certification, of assured supplies of superior strains of plants important in permanent pastures has added to the number of farms on which the use of the plough is profitable as a step towards improved swards. Before assured supplies of persistent strains of such important pasture-plants as perennial rye-grass, cocksfoot, and clovers became obtainable there was always a danger of a new pasture not for long being superior to the poor one which it displaced. But this danger can now be avoided by the use of certified seed: inferior open pastures can, with practical certainty, be replaced quickly by good ones of reasonably long life by ploughing, sowing good strains of permanent plants, and suitably maintaining fertility by such measures as top-dressing. As a legacy in some measure from the time when assured supplies of persistent strains of the principal pasture-plants were not obtainable, there is still a tendency to repair pastures when ploughing should be the first step to their renewal. While it may be possible to repair a pasture by top-dressing, harrowing, and surface-sowing of seed, the quicker and more thorough result obtained by renewal often makes the renewal economically preferable.

It is also generally advisable to grow arable crops such as mangels, swedes, chou moellier, &c., when this can be done without any substantial direct outlay in equipment and labour. And this applies usually even to farms the pastures of which are not especially in need of renewal. In short, if cropping can be carried out without neglect of some of the necessary routine work of a farm and without necessitating the employment of much additional labour, then it is probable that cropping should be done.

Expansion in Ensilage advisable.

The fact that on many farms there is a strong case for expansion of special forage cropping does not justify the conclusion that ensilage already

is being carried out as much as is desirable. Actually there is wide scope for profitable expansion in ensilage, firstly by the adoption of ensilage by many of the considerable number of farmers who have not yet resorted to it, and secondly by the expansion of the area of ensilage on many farms on which it is carried out regularly. In many circumstances the most suitable farming programme is the one which gives a place to both special arable cropping and to ensilage, together with haymaking when the weather favours the making of good hay.

Special Long-term Crops.

The increasing attention being given to certain crops is worthy of mention. These crops under suitable conditions serve for many years as a direct supply of feed during periods when the feed directly available from pastures is scant. Lucerne for summer use and subterranean clover are outstanding examples. Such crops minimize the role of both special arable crops and ensilage, and it seems desirable that they play a much bigger part in the future than they have played so far.

Main Factors governing Yield of Arable Forage Crops.

One of the key factors in successful arable cropping is adequate cultivation: the best possible returns are not obtained from judicious expenditure in other matters such as seed and manure unless such expenditure is associated with cultivation thorough enough to give throughout the growing-season of the crop a good supply of moisture and air in the soil, together with conditions for the development of a good root system. The preparatory cultivation for forage crops is often markedly below the full possible requirements of the crop, and so a poor crop may be foretold even though liberal manuring and the use of the best seed is practised. When an arable crop follows old pasture a common and grave weakness is failure to break down the old turf enough to ensure not only free movement of soil moisture, but also free development of roots, both of which may be checked by the pockets of air often to be found below a buried turf which has not been well broken down. Skim-ploughing or disking of a turf before ploughing it down is at times of assistance in breaking it up sufficiently.

Another important factor in good yields is the use of good seed. Commonly a small saving in seed is correlated with poor germination or low vigour of seed or with poor type or strain of plants. There is evidence that some of the complete or partial failures, such as poor "strikes," which have been attributed to unfavourable weather, pests, &c., are due essentially to poor seed.

A further factor, often of importance, is liberal manuring to give enough plant-food material to ensure that the supply of such material is not an unduly limiting factor in yield. The error of under-manuring is widespread: this may be realized from the fact that, while the value of 1 ton of even the least nutritious of forage crops is more than sufficient to pay for 1 cwt. of the fertilizer commonly used with them, it is but seldom that 1 cwt. of manure does not give an increase in yield of considerably more than 1 ton an acre.

The Mangel.

Good treatment of the mangel is particularly advisable—in the absence of a fine firm seed-bed such as is most easily obtainable by early and thorough cultivation, poor yields may readily result. Over wide areas, November sowing is suitable, and as wet or cold conditions tend to lead to loss or stunting of seedlings sowing should be deferred until warm soils may be expected. Standard practice is to sow about 6 lb. of seed an acre in rows 26 in. to 28 in. apart. Based on its tonnage an acre, Prizewinner Yellow Globe is the most popular variety, but considerable areas of other varieties of known value such as Red Intermediate, Long Red, Golden

Tankard, and Jersey Queen are grown. While manurial requirements vary considerably according to soil and climate, field experience shows that good results may be expected over wide areas from a dressing of 5 cwt. to 6 cwt. an acre of a mixture consisting of equal parts of superphosphate and blood and bone or three parts of superphosphate to two parts of blood and bone. Kainit, which contains 14 per cent. of potash as well as a considerable amount of common salt, may be added when there is evidence that the mangel crop would benefit from potash.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Cultivation.

THE cultivation of the soil should continue to receive special attention. The ground should be worked down to a depth of from 3 in. to 4 in., so as to conserve the soil-moisture and to allow of the free access of air to the soil. To maintain the full benefit of cultivation, the formation of a crust when the land dries after rains should be prevented by stirring the soil immediately it is dry enough to work. Ploughing in the orchard at this time of the year is not recommended, as the deeper cultivation seriously disturbs and destroys many of the feeding roots: this causes a considerable reduction in the food-supply of the trees at a vital period of their life—that of fruit setting and stoning. In localities where spring ploughing has not been completed owing to the condition of the soil or to other circumstances, every endeavour should be made to have it completed as soon as possible, and preferably at a reduced depth.

Fertilizers.

Growers who intend to make an application of nitrogenous manure during the spring should do so during the present month.

Spraying.

Spraying for pests and diseases should be along the lines set out in these notes in the September *Journal*. The wet weather with hot days intervening, which has been recently experienced, was favourable for the development of fungi such as black spot and brown rot. Growers are urged to apply sprays thoroughly and to cover the whole surface of the tree including the fruit with a protective film of spray. It is just as important to spray the underside as it is the upper surface of the leaves and fruit.

Planting.

Trees planted during the spring which are growing now should be carefully examined and only three good shoots should be left; these shoots should be about 3 in. to 4 in. apart on the trunk of the young trees. No two or more shoots should be allowed to start from the same point, as if these are allowed to grow, then when the trees commence to carry a crop the branches are liable to split away from the trunk.

On two-year-old and older trees planted this season shoots likely to interfere with the proper development of the main or leader shoots should be suppressed.

Budding and Grafting.

If stocks on which buds have been worked have not already been cut back, this work should be attended to at once, so as to encourage a straight trunk, or branch. The cut should be slanting and slightly lower on the side opposite the base of the bud. In windy situations the shoots should be tied to and supported by stakes driven firmly into the ground to prevent them being broken off before they become properly established.

When grafting has not been completed this should be completed as early as possible, as the weather may soon become hot and dry, and under these conditions grafting may not be entirely successful. Grafts that have "taken" should be examined, and where necessary the ties should be loosened around the scions to prevent the material cutting into them as they swell. It is advisable to rewax the grafts where necessary. The shoots arising from the stock should be pinched back, except those arising from a suitable position for budding in the autumn should any of the grafts fail to take. Later in the season, if not required, the latter should be pinched back. In exposed situations the scion-growths should be tied to protect them from damage by wind. To do this a stake should be driven firmly into the ground beside each branch grafted, and then the growth should be tied to the stakes.

Thinning of Fruit.

One of the many questions that is exercising the minds of the leaders of the fruit industry is the matter of keeping inferior fruit off the markets. The most successful way of solving this problem is for growers not to grow inferior fruit. It should be the endeavour of every fruitgrower in the Dominion to produce better fruit. It should not be a question of how many fruit a tree can be made to produce, but the paramount aim of every grower should be "quality." As a rule trees set and mature two to four times as many fruit as they should be allowed to do, and if the crop is not thinned sufficiently according to the vigour of the tree there results a large percentage of inferior fruit, with a correspondingly small proportion of high-grade fruit. There is more money in an average crop of high-grade fruit than there is in a heavy crop of small inferior fruit. Hence, why allow the trees to continue to produce fruit which is unsatisfactory to the grower, fruit-merchant, retailer, and consumer, when the position can be greatly improved by consistent thinning? If a grower has not thinned his crop already, then he should do so now, and he will be well repaid for the labour entailed. Thinning should be commenced in the early stage of the growth of fruit; if left until fruit is well grown the tree becomes exhausted and cannot produce the superior article that is required. Some growers prefer to do the thinning by hand, but the use of special thinning shears is recommended, as when thinning is done by the fingers the remaining fruit is often loosened, with the result that it soon falls.

The leaf-roller caterpillar, which does more harm in some districts than does codling moth, is more readily kept under control if single fruit only are allowed to remain.

—B. G. Goodwin, Orchard Instructor, Christchurch.

Citrus-culture.

During the spring and throughout the summer disease-control is an important part of the work in a citrus grove. The old slogan "prevention is better than cure" holds good, particularly in the case of fungous diseases. Spraying by the calendar is of very little value. Each grower must make careful observations of the stage of tree-growth, the hatching of insect pests, and of the first signs of disease in his own orchard. This task often can be carried out during picking operations. When the identity of any disease is doubtful, specimens should be forwarded to the local Orchard Instructor for identification. Particulars of the circumstances under which the specimens were found should also be supplied. It is necessary that the cost of production be reduced, and, while this cannot be accomplished by the omission or the curtailing of essential spray-applications, much extra expense is often incurred by the failure of orchardists to recognize the incipient stages of disease in their groves.

Verrucosis is a disease which, once it has become established in an orchard, is liable to spread rapidly if weather conditions are favourable

and control measures are lax. The main measure of control is to protect the young fruit from infection by a covering of Bordeaux 3–4–50 as soon as they have been formed. Although the blossoming of lemons is almost continuous, there is a distinct main flowering period which occurs (with most varieties) in the late spring. In ordinary circumstances, where verrucosis has been kept under control, the fruit-set application is all that is necessary. On the other hand, in cases where the disease has been prevalent, an additional application of Bordeaux at the pre-blossom stage serves to destroy any infection which arises from lesions on old fruit, leaves, and shoots. Where the trees have been worked on rough lemon (citronelle) stocks, a search should be made for suckers which have grown up from the roots—such suckers should be removed, as they are exceptionally susceptible to the disease. Citronelle stocks in a nearby nursery may also be a source of infection.

Melanose is a disease which attacks fruits, foliage, and shoots: infection takes place when these are young and tender. It is controlled by spraying at early fruit-set, and, where Bordeaux is applied for verrucosis control, further spraying is not necessary, but the cutting-out of dead and badly infected wood is advisable.

Bark-blotch becomes active in the spring, and the trees should be systematically and thoroughly examined for the tell-tale gumming and diseased bark which is typical. It is not enough to walk casually up and down the rows of trees. In old groves in particular it may be necessary for the person making the examination to get down on his hands and knees in order to make a close scrutiny of the bark of the trees, especially that near ground-level, where perhaps injuries made by hoe or cultivator have afforded a means of ingress to the disease. Bark-blotch can be more readily controlled if it is detected in the early stages while the infection is confined to small areas. If the disease is widely spread throughout the grove the small infections should be attended to first. When a tree becomes so badly diseased that it no longer produces a reasonable quantity of good fruit, it should be removed without further delay and replaced with a young tree. This practice is quite safe, provided that a large-sized hole is dug, and that this is filled up again with fresh soil. The method of treating the disease is to cut out the diseased bark, right down to the wood, and well into clean bark at the edges. These should be left smooth to facilitate the formation of callus. The wound should be swabbed with acidulated mercuric chloride, and then, when dry, painted over with a wound-dressing such as a bitumen emulsion.

Black Aphis. — Where the aphides are so numerous that they detrimentally affect the growth, particularly on young trees, spraying is advisable. Summer oil 1–80 or nicotine sulphate, 40 per cent., 1–800 plus soft soap 4 lb. to 100 gallons is effective, provided good contact is made with the pest. This necessitates careful work, directing the spray right into the clusters, which are often protected by curled-up leaves. *Aphelinus mali* parasitizes this aphis, and may be expected to minimize infection to a considerable extent.

Thrips.—The control of this pest is often overlooked, and the loss it has caused by the reduction of the grade of fruit through russet has not been fully realized. Experiments which have been carried out indicate that little control is obtained in the spring, probably because the blossoms afford excellent protection to the thrips, which are able to take cover well down between the pistils and stamens. After the fruit has set there is less cover for the insects, and they may be controlled either with lime sulphur (polysulphide content 15 per cent. at 1–40 to 1–80, or nicotine sulphate, 40 per cent., 1–800 plus soft soap 4 lb. to 100 gallons, or the two may be combined, in which case the soap should be omitted). Care should be taken to see that lime sulphur is not used at too close an interval to oil sprays, otherwise scorching may occur. A suitable time to apply this spray would

be three or four weeks after the Bordeaux applied at fruit-set period. Where the pest is very prevalent, the nicotine sulphate should be included in the Bordeaux spray as an additional check. A good pressure and thorough work is very desirable.

In connection with the use of Bordeaux mixture, it is now standard practice to add a summer oil at a dilution of 1 per cent. This improves the wetting and spreading properties of the spray.

Reworking.—Unfortunately, just as with other kinds of orchards, many citrus groves contain a number of trees which have to be worked over for some reason or other, such as variety unsuitable to the locality, unpopularity of fruit on the market, poor bearing strain, or perhaps the production of rough off-type fruit.

Although grafting may be practised, the method almost universally used for citrus trees is budding. Grafting, particularly when the stock wood is heavy, necessitates very careful work, and very often there is a weakness owing to the large wounds, which take years to heal over, during which time there is a danger of the entry of borer or fungous disease. Small trees or light wood on older ones may be grafted by the whip or rind graft. Citrus trees should be grafted in the late spring, when they are in active growth.

Budding.—Except during the winter, when there is little or no growth and the bark does not lift freely, citrus trees may be budded almost at any time. The two main periods for this work are spring and autumn. Spring budding may now be proceeded with. Any approved method may be used such as the inverted "L" or "T" or even the erect "L" or "T." The buds should be obtained from trees which are known to be producing heavy crops of fruit of good quality. Care should be exercised in selecting the type of bud-wood, and sticks which are round should be taken in preference to angular ones, and they should be of good normal growth of about the diameter of an ordinary lead-pencil. If the trees to be worked over are young, there is no difficulty in locating suitable wood for budding. In small-branched trees it is best to insert a bud into each of the limbs, fairly close to the trunk. By inserting a number of buds one ensures that the failure of one or two buds does not cause any delay in starting off the new variety. The reworking of old trees is a more difficult task. Here again it is advisable to work on the younger wood as much as possible. It is desirable that the process of changing to the new variety should extend over a period of two or three years. By this procedure the balance of roots over top is well preserved, and the young growth from the buds is less liable to be flooded by an excess of sap.

General.—Cultivation and cleaning round the trees should be continued. Particular attention should be paid to any newly planted trees to see that they do not become loose, as root damage may develop in loose trees and a soil pocket may be formed round the trunk, and this may hold rain-water if the soil is retentive. Picking should be kept up to date.

—A. R. Grainger, Orchard Instructor, Tauranga.

POULTRY-KEEPING.

The Breeding-pens.

AT the close of the breeding-season many poultry-farmers are faced with the breaking-up of their breeding-pens and the disposing of all surplus cock birds. Before doing this, it is well to consider the advisability of retaining one or two of the very best for special matings during next season. Where flock mating has been practised and the leader of the pen is observed to be an outstanding bird, it would be advisable to hold him until at least there has been time to test out his pullets.

Every season some very valuable birds, which should have been retained for further use, are sold for a few pence. This point is mentioned as on several occasions plants have been visited where an extra fine lot of pullets has been raised, and on asking to be shown the sire of these pullets the Instructor has been told that it is a practice each year to sell all cock birds as soon as the hatching season is over, as cockerels are more satisfactory for early breeding.

While it is economical and a good plan to get rid, as soon as possible, of all cocks that show any sign of not being of any further use, it is, however, well to remember that a prepotent male, one that leaves stock of extra high quality, is a very valuable asset on any farm, and such birds should be retained for special mating for as long as they will produce that quality of stock so much desired. Birds possessing the characteristics indicated are rare and are not easy to breed, and so every care should be taken to make the very best use of them.

Toe-picking amongst Chickens.

Each rearing-season information is sought in reference to the cause of and remedy for that annoying cannibalistic habit of chickens toe-picking one another. As the causes may be varied it is very difficult to advise poultry-keepers without examining the stock and knowing something of the conditions under which the chickens are being reared. Indications at times tend to show that this is a deficiency trouble, perhaps in some cases the result of faulty incubation, or the breeding from pullets or hens that were forced for egg-production and were somewhat exhausted and consequently not in the best condition to produce eggs which in turn would produce perfect chickens. Contributing causes may be overheating of the blood by feeding a deficient diet, or even too much bright light under the hovers. At the first signs of the trouble the chicken that has been attacked should be separated from the rest and the affected parts should be painted with creasote or iodine. Plenty of straw chaff should be provided in the brooder-house, so that the chickens may bury their toes in it. Finely-cut succulent green food should be given three times a day, and a trial should be made of giving the last lot after the last feed of broken grain at night. The addition of milk and a little more animal food to the ration should help matters. If this trouble gets really bad it is well to darken the brooder-house for a few days in order to prevent the sun from shining in on the toes of the chickens, as the trouble is often started by pecking at one another's toe-nails.

Green Food.

As nothing does more to keep birds in good healthy producing-condition than a regular supply of a variety of succulent green food, it is well to make provision for a good supply now that the weather is getting warmer. No poultry-keeper ever regrets giving his young growing stock as much succulent green food as they will eat.

A patch of silver-beet is very useful. Stock of all ages are very fond of this green food, and, owing to its freedom from insect pests and disease and the enormous amount of succulent green leaves and stems which it produces, silver-beet is one of the most popular green-food plants. This plant may be sown in the spring or in the autumn, and it stands transplanting well. Green oats and barley make fine green food, when chaffed, and may be regularly grown during most of the year.

Chou moellier is another plant that supplies a great amount of attractive green food, and could with advantage be more widely grown by poultry-keepers, especially where winter green food is difficult to get. Where a stand of lucerne can be established it proves a valuable asset, and, where insect pests are not troublesome, kale and rape make a very pleasant change.

When rearing chickens in the natural way with hens, if they have not access to young grass they should be regularly supplied with tender green food.

Stale Ground.

As stale ground is responsible for a great deal of the unthriftiness amongst young stock, it is well to see, if at all possible, that all young stock are reared on fresh sweet ground. If birds are reared on stale ground their growth is usually checked and they seldom develop well, with the result that when they come into profit their eggs are usually small. It is well to encourage young stock to roost early. Leghorns and other light breeds should be ready to perch at about seven weeks old, and the heavy breeds a couple of weeks later.

As Leghorn cockerels are usually very precocious, it is advisable to separate the sexes as soon as possible, as both cockerels and pullets grow better when reared separately.

Growing stock should never be stinted; though a four-months-old cockerel eats as much as an adult bird, it should be given all it will eat. If separated from the pullets and given plenty of good plain food, all surplus cockerels should be ready for the market at from four and a half to five months old. This is the best age to sell cockerels, for as they get older they usually lose condition and are really of less value as table birds.

A well-primed four-and-a-half-months-old cockerel usually brings a higher price on the open market than one eight months old, as the latter is what is known to the poulterer as a "stag." When it is desired to produce prime cockerels it is advisable to confine them in small clean pens so that they do not get too much exercise. Their food should consist of mash three times a day, as much as they will eat. A mixture of one measure of bran, three of pollard, and one of maize-meal, with from 5 per cent. to 7 per cent. of meat-meal added, the lot being mixed to a fairly crumbly condition with skim-milk, will give good results. Plenty of green food and, where available, milk can be given to drink as well as water.

Great care should be taken to avoid the crowding of poultry, especially young growing birds, for more culls are made this way than any other. If one finds that more young stock have been hatched than what there is accommodation for, it is much wiser to get rid of the extra birds as soon as possible and give the remainder every chance to develop into profitable stock than to try and hold on to the lot and thus overcrowd.

The Water-supply.

A test carried out at this Department's Wallaceville Poultry Station showed that forty hens drank 3 quarts of water during one day in June, whilst the same birds consumed 6 quarts 1 pint during one day in July, and 6 quarts 3 ounces during one day in August. The test also showed that when hens are laying they drink over twice the quantity of water that they do when they are not producing. When with these facts it is remembered that one dozen of new-laid eggs contains almost 1 lb. of water, and that the flesh of fowls and their eggs contain from 60 per cent. to 70 per cent. of water, the great importance of a good water-supply must be recognized. At times there is a tendency by some poultry-keepers to overlook the great importance of this very necessary item of successful poultry management. As nothing reduces egg-production more quickly than leaving hens short of water, it is not only cruel but most uneconomical to deprive hens of a regular supply of clean water. If young growing stock are left short of water they fail to develop properly. Most large poultry-farmers have spent much time and money in designing a suitable watering-system for their birds, and many have arranged gas-taps so that there is a constant drip of water into the drinking vessels. A good watering-system is shown in this Department's Bulletin No. 66, "Utility Poultry-keeping," copies of which may be obtained from the publisher, Department of Agriculture, Wellington, at a cost of 1s. each, postage free.

Whatever system is adopted, care should be taken to see that all birds have a plentiful supply, and as disease is often transmitted from one bird to another by means of the drinking-water, it is essential to see that water vessels are kept in a clean and sanitary state.

Chick-sexing Examination.

Chick-sexing examinations were conducted by the Department at the Wallaceville Poultry Station and at Christchurch at the end of August. In all, eight students undertook the examination, and two were successful. Mr. J. C. Jamieson, who sexed 100 chickens in eighteen minutes with an accuracy of 91 per cent., qualified for a second-class certificate. Mr. D. E. Hopkins, who holds a second-class certificate and who sexed 50 chickens in nine minutes and a quarter with an accuracy of 96 per cent., qualified to have his certificate endorsed.

—C. J. C. Cussen, Chief Poultry Instructor, Wellington.

THE APIARY.

Seasonal Preparations.

OCTOBER is perhaps the month when the apiarist can do most in helping his bees to work up to full strength in time for the main honey-flow. In the warmer parts of the country swarms may be looked for about the middle of the month, but in the southern districts they probably do not appear until three or four weeks later. By 1st October, unless the weather for some weeks has been cold and wet, every hive should have been examined and its condition noted with regard to stores, population, and health.

No colony should be allowed to dwindle because it has not sufficient food to provide for the offspring of a prolific queen. On the other hand, some beekeepers prefer that all the old honey in the hive should be used up before the new season's flow commences. The food-supply of the hive is sometimes an exceedingly puzzling matter, as it varies considerably in accordance with the weather and the strength of the colony, and only periodical and systematic examinations can settle the question as to whether all is well with the hives in this respect. No harm can be done by feeding good white-sugar syrup, but a hive which is starved in the spring probably does not recover its strength till the main honey-flow is nearly over. By the middle of October, under normal weather conditions, every hive should have at least four frames of sealed brood, and many have more. Those that have fewer, unless their food-supply is very short, should be marked for requeening as soon as possible. The apiarist's endeavour should be to keep his colonies as even as possible, thereby obtaining a uniform surplus throughout the apiary.

Wherever there is a fair yield of nectar from spring flowers the beekeeper would do well to take advantage of the warm days of the month to treat any cases of disease which he may have noted earlier in the spring. However, no hard-and-fast rule can be laid down in this matter, as everything depends on locality and weather conditions. In some districts it would be almost suicidal for the beekeeper to treat his bees in October; in others, where right conditions prevail, it may be carried out with ease and safety, and the bees brought into good condition by the time a surplus may be expected. Wherever treatment has been undertaken, the colonies should be watched in order to see that there is no danger of starvation, and where the spring flow is not considered heavy enough it should be supplemented by liberal feeding.

Hiving Swarms.

In most text-books on beekeeping this kind of advice is given: "When a swarm settles into a cluster take a light box and shake the bees into it," &c. This advice is of use where the bees are accommodating enough to settle into a convenient position for the shaking process to be carried out. Unfortunately, in many cases bees get into positions whence it is impossible to dislodge them quite easily. Sometimes they settle on a small bush, and much of the cluster is on the ground. In this case probably the best thing to do is to place the box over the cluster, and if the bees do not show much disposition to climb up into the box they may be persuaded to do so by the use of a little smoke. When they cluster in the centre of a prickly hedge the box should be placed on one side of the hedge, and the beekeeper should puff smoke from the other side of the hedge, and thereby drive the bees towards the box. In the event of the swarm taking possession of a fencing-post and clustering on it from top to bottom, as they occasionally do, the smoker must again be used, and, in addition, it is as well to brush the bees from each side of the post in turn into the swarm-box with the brush which is used for the frames at extracting-time.

The usual practice is to leave the box sheltered from the sun and covered with a sack near the place where the swarm has settled. Where few hives are kept this may be done with impunity, but if other swarms are expected it is well to remove the box to the place where the colony is to stand permanently, otherwise before the close of the day the probabilities are very largely in favour of the box being taken possession of by three or four other swarms—a matter of annoyance to the man who wishes to keep his swarms separate.

In every case a swarm should be attended to as soon as it settles. Many people are under the impression that swarms should be left undisturbed till nightfall, but this idea is an erroneous one. They should invariably be placed in the box as soon as possible after the cluster is formed, and put so that they are sheltered from the rays of the sun.

Water-supply.

One of the most important of the minor details of apiculture is the provision of a constant water-supply for the purpose of assisting the bees in brood-rearing. Not only is it necessary to conserve the energy of the bees by having the water close at hand, but it is well to ensure that they do not prove a nuisance at taps, cattle-troughs, &c. From early spring till late autumn water is an absolute necessity to bees, and they consume comparatively immense quantities in fine weather. It thus behoves the beekeeper to see that a liberal supply is always available. By establishing his drinking-fountain early in the season he teaches the bees where to go for supplies, and ensures their always seeking the same spot for water.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

In seedling crops sown outside thinning and weeding are now among the most important operations; neglect at this stage is a common cause of poor crops. Where the land is properly prepared and seeds are sown thinly, weeding and thinning need not be very tedious. By ploughing, harrowing, and cultivating sufficiently early to allow weed-seeds near the surface to sprout and be destroyed before the crop is sown, what may be called a clean start is obtained. Under the best conditions, however, some weed-seeds sprout with the crop in about a fortnight, and, on the first fine day when the land is sufficiently dry, they should be destroyed by hoeing,

thus disposing of them easily before they grow past their seed-leaves. This attention must by no means be omitted, but should be repeated as required until the crop spreads sufficiently to check weed-growth. Thinning takes a great deal of time, patience, and care, but is much reduced by studying the seeds and knowing their nature and condition, especially germinating-capacity, and sowing them at the most suitable rate. Incidentally seed sown at a suitable rate generally sow an area twice the size of that sown at ordinary rates. Whichever way is adopted the seedlings must be suitably spaced to produce good plants. These are not such as cause wonder at their great size; good plants of this description are usually of moderate size, as they are better for the table, and probably yield as heavily per acre as larger specimens if the thinning is not excessive.

In the cooler districts where half-hardy vegetable crops, as tomatoes, &c., are grown, they are planted out during the first week in November, or as soon after as weather permits. On light land, especially where it is inclined to be dry, clean summer cabbage, or other green vegetable of that class, is difficult to grow unless silver-beet is sown in early spring, or New Zealand spinach (*Tetragonia expansa*) is planted out now about 2 ft. or 3 ft. apart in the row. The latter is a vegetable of high repute overseas and should be more extensively grown in this its native country, where it is commonly found growing wild on light land near the coast. It is a wholesome vegetable which cooks to a good colour, and is even more palatable than most vegetables of its class. Furthermore, it is little troubled with pests and diseases.

Celery is in good demand, and should be planted out so soon as the plants are available. In dry localities it is planted in trenches to facilitate watering; elsewhere it may be planted out on flat land. For the early summer crop—and the late crop also in the warmer districts—the self-blanching varieties are most suitable. A good crisp variety of lettuce may be sown now to mature without transplanting. This seed usually germinates freely, and for growing in this way should be sown very thinly. In cool districts the garden swede turnip is sown during the month of November. Where it is desirable to grow this vegetable in warmer localities, it is best to defer sowing until the month of January.

In the unheated glasshouse the tomato crop commences to ripen during the month of November. Under the crowded planting conditions liquid fertilizers should be given to finish the crop well, so that the greater part of it is marketed before the end of January when the outside crop begins to ripen. In the absence of local experience the following mixture may be tried and modified as it is found desirable: 1 oz. superphosphate and ½ oz. each of sulphate of potash and nitrate of soda, in liquid form, per square yard. On light land inclined to dry out it is usually an advantage to mulch with strawy stable manure which assists in retaining moisture as well as feeding the crop to some extent. In preparation for this application the exhausted leaves at the base of the plants are trimmed off, taken out of the house and destroyed. On bright days when the temperature rises above 65° F. all the air possible should be given. The high temperatures frequently found in the houses during summer are detrimental to this crop.

Small and Sundry Fruit Crops.

The small-fruit harvest now commences with the culinary gooseberries; and one kind or the other is available to the consumer during the months of November–December, with the season straggling into the following months. These berry crops ripening in summer between the long seasons for tree fruits are most popular for all of the purposes to which culinary and dessert fruit may be applied. Some of them are perishable, but with an improvement in the system of distribution the public would doubtless gladly take greatly increased quantities. The fruitgrower who neglects the study of the marketing side of the business misses many of the profits.

The successful grower is usually one who rather specializes on this phase of the industry. With small fruits good packing and prompt despatch the same day as the fruit is picked are important points. Clean picking avoids the production of over-ripe fruit which so often stains an otherwise good pack and gives a bad impression when opened up by the consignee. In long-distance shipments especially this fault should be carefully avoided.

Strawberry-beds are mulched as soon as the crop commences to set. This is specially important where the soil is inclined to be light, and gritty particles of soil are splashed on to the berries during rain unless the mulch is laid. Baled straw is most suitable for this purpose, but rushes and pine-needles are often used with good results.

Many varieties of red currants now make vigorous growths, which are often blown out by strong winds. By "stopping" them before this happens the growths are hardened up, become more fruitful, and loss is avoided.

The Homestead Garden.

The early part of the month of November is usually the best time for planting out half-hardy annual flowering-plants. In some gardens where a gay appearance during the summer season is desired this is often an important feature which demands experience, taste, and a good deal of consideration to carry out in the best style. It is probably most popular and effective in towns where the residents have a comparatively restricted outlook. Country gardens, however, may often be made more attractive and a little diversity introduced by planting out a bed or comparatively large group of stocks, asters, zinnias, &c., in a well-chosen spot. Where a good supply of humus is present some bonedust and a little "complete" manure worked in bring the plants away quickly and ensure a good display.

In some situations climbing-plants may be allowed to ramble, but under most conditions the display is more effective if the plants are trained by controlling the growth and tying it in over as wide a space as is desirable. Control is obtained generally by stopping new growth which is not required by pinching out the tip after a few leaves have developed, and tying in that which is needed. Periodical attention of this description during the summer months gives superior results very quickly. Wistaria, bignonia, bougainvillea, &c., are attractive plants which are at their best when trained in this way. It should be remembered that young plants of this kind planted at the foot of a wall usually suffer from a lack of moisture until they have made considerable growth and the roots have spread out into the moister soil. Liberal watering and a surface mulch during the summer months therefore are of great assistance in the early stages.

When the half-hardy annuals have been disposed of it is customary to sow herbaceous perennial flowering-plants for autumn planting and biennials for a display during the winter and spring. Many spring-flowering perennials may be increased by division, soon after flowering ceases.

Many inquiries are received regarding the composition and extent of plantations, hedges, and shrubberies for various purposes. Usually these can be specified with the best results only after carefully studying the locality and giving consideration to the object in view. Hurried decisions are the cause of endless disappointments in this regard. Those who have the management of land, whether the area be large or small, should closely study the growth of plants of this kind in their locality. Trees and shrubs for timber, shelter, fruit, or ornament are among the important crops grown on a farm, and should receive the consideration given to others. In fact, owing to their more permanent character and dependence on local conditions, they require much more consideration if they are to be grown with any real measure of success. Failure in the past has been due not so much to management as to the selection and arrangement in the first place.

The summer season is most suitable for thoroughly studying the behaviour of trees and shrubs under one's local conditions, especially in local public and private plantations and gardens, also the nurseries. The owners usually have much information about the plants which have been grown, and generally find pleasure in discussing them with any one who is really interested, as an exchange of experience is of mutual value and advantage. It is important to obtain the correct name of a plant under consideration and write up the information obtained so that it may not be lost. By restricting the scope of the study and inquiry to features of immediate interest the labour need not be great, and one is ready to give practical application to the information obtained when the planting-season arrives, either by extending the plantations or modifying those already established.

—*W. C. Hyde, Horticulturist, Wellington.*

REVIEW.

Flour-milling Processes, by J. H. SCOTT. 416 pp. Chapman and Hall, Ltd.

IN flour-milling research has added in recent years knowledge which begets development, and this book meets the need of those desiring to keep up to date in their knowledge of the flour-milling processes. The book is based largely upon the considerable personal experience of the author, but, when advisable, the observations and results of other authorities are cited. The author indicates that he considers that finality has not yet been reached in flour-milling, but aims to present a relatively complete picture of our current knowledge. In this he has achieved such success that the book contains information of real value to both theoretical students of flour-milling and to practical flour-millers.

Evidence of the trend towards improved farming continues to be provided in the maintenance of a relatively heavy, and in several instances an increasing, use of certified seed. In the 1936 harvest there were record acreages devoted to the production of certified seed of potatoes, wheat, white clover, cocksfoot, and Italian rye-grass, while the perennial rye-grass acreage increased in comparison with that of the previous harvest. The major portion of the certified seed produced is used by the farmers of the Dominion, and from the superior characters inherent in certified seed its use makes possible increased production of crops and pastures.—*Annual Report, Director-General of Agriculture.*

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WEATHER RECORDS: SEPTEMBER, 1936.

Dominion Meteorological Office.

NOTES FOR SEPTEMBER.

SPRING characteristics were very strongly developed in the weather for September. Pressure was almost continually low in the south, and there was consequently a persistence of westerly winds, which were frequently strong and squally. The weather changed rapidly and there were few days on which western and southern districts failed to experience a certain amount of rain. East of the ranges conditions were finer and more sunny. Until the 19th, temperatures were generally low, and although the last ten days were milder, they did not quite make up for the earlier cold. The wet and cold weather retarded growth of vegetation in western and southern districts of the South Island and over most of the North Island, where frosts were rather numerous. In Hawke's Bay, about Wellington, in Nelson, and the Marlborough Sounds, there was rapid growth, and the season is well advanced. There is no shortness of feed for stock anywhere, though in some places feed is rather soft. Stock are reported to be in good condition, and the lambing-season, in spite of some losses due to cold and strong wind, appears to be progressing satisfactorily. In eastern districts of the North Island a good warm rain would be beneficial, while in western districts and the high country generally a spell of dry, sunny weather is desired.

Rainfall.—Though there were no very heavy general falls, rain was frequent throughout the month in all districts with a westerly aspect, and most of Otago and Southland. In eastern districts from Canterbury northwards and also in the Bay of Plenty area and Nelson the totals were generally below average. Elsewhere they were above, the month being very wet in western Otago and Southland.

Temperatures.—Temperatures were everywhere below normal, though the departures were not large. In western districts they were generally about 1°·5 F. but elsewhere seldom as much as 1° F.

Sunshine.—The persistent westerly weather caused a lack of sunshine on the west coast of the South Island and in Southland, while, according to the New Plymouth record, Taranaki recorded about the average amount. Elsewhere totals were above average, and eastern districts experienced a very sunny month. Blenheim had 225·6 hours and Napier 210·6.

Pressure Systems.—The sequences of pressure changes experienced throughout the month were remarkably constant in character and typical of spring. The anticyclones all passed well to the north of New Zealand and a series of westerly depressions, each followed by several secondaries, moved rapidly from the west across the South Island. Winds blew almost continuously from some westerly quarter, and gales were frequent in some part or other of the Dominion. During the first few days cold south-westerlies prevailed. Conditions were especially boisterous on the 3rd to the 4th, when there were widespread falls of snow in both Islands.

There was some variation in the type of weather from the 21st to the 25th. An intense anticyclone was centred near Chatham Islands from the 22nd to the 24th. This brought northerly winds and warmer weather over New Zealand. A shallow cyclone developed just to the north-west of the Dominion and moved in an east-south-easterly direction across the Bay of Plenty. By the 26th, however, the westerly type of weather was again fully restored.

Thunder and hailstorms were rather numerous during the month, especially in western districts, and a tornado occurred near Tauranga on the 10th. In addition to that mentioned in reference to the 3rd and 4th, snow fell on the high country on the 6th, 18th, and 26th and 27th. At the end of the month the ranges were well coated.

RAINFALLS FOR SEPTEMBER, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average September Fall.	Total Rainfall to Date.	Average Rainfall to Date.
			North Island.			
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	3·58	15	1·12	4·90	44·47	43·66
Russell	4·57	13	2·15	3·89	76·49	41·19
Whangarei	4·68	20	0·99	4·85	54·12	49·95
Auckland	3·69	19	1·43	4·05	42·57	38·52
Hamilton	4·36	18	1·39	4·32	41·79	37·43
Rotorua	3·63	9	1·54	4·97	51·13	41·83
Kawhia	4·17	17	1·20	4·57	45·76	40·75
New Plymouth ..	6·32	25	1·11	4·92	47·77	45·33
Riversdale, Inglewood ..	8·29	25	1·05	9·56	75·92	77·16
Whangamomona ..	6·67	17	1·10	7·11	56·39	56·10
Hawera	4·58	15	1·02	3·42	36·45	33·53
Tairua	3·09	17	1·30	4·92	42·26	50·63
Tauranga	3·11	18	1·20	4·29	45·53	40·41
Maraehako Station, Opotiki	4·80	15	1·26	4·21	54·63	41·94
Gisborne	1·21	11	0·29	2·99	35·95	37·28
Taupo	3·63	13	1·28	3·82	39·69	33·12
Napier	1·67	8	1·10	1·93	40·50	24·23
Hastings	1·23	10	0·62	2·63	35·08	26·05
Whakarara Station ..	2·20	13	0·28	..	44·36	..
Taihape	4·07	19	0·82	3·04	35·77	26·56
Masterton	1·81	13	0·52	3·00	38·08	29·54
Patea	4·79	22	0·83	3·59	39·03	33·03
Wanganui	2·99	8	1·00	2·87	32·03	26·72
Foxton	2·76	14	0·58	2·40	32·07	23·73
Wellington	2·44	16	0·77	3·20	42·95	32·87
			South Island.			
Westport	8·68	22	1·00	8·30	60·80	70·80
Greymouth	8·22	24	1·40	8·09	66·29	73·06
Hokitika	11·25	23	2·90	9·02	75·24	82·31
Ross	16·99	25	4·37	12·43	90·32	94·81
Arthur's Pass ..	9·56	17	2·13	15·29	87·83	111·36
Okuru, South Westland	16·31	16	2·05	11·89	110·44	105·69
Collingwood	6·25	20	1·31	9·31	71·44	71·76
Nelson	3·37	12	0·73	3·58	31·54	28·44
Spring Creek, Blenheim	2·27	11	0·80	2·59	28·30	23·23
Seddon	1·71	9	0·52	2·14	22·70	18·76
Hanmer Springs ..	3·82	14	1·00	4·43	43·12	33·91
Highfield, Waiau ..	1·62	8	0·57	2·99	29·91	25·52
Gore Bay	1·28	7	0·44	2·94	28·42	24·25
Christchurch	2·07	11	0·75	1·93	27·66	18·92
Timaru	0·96	7	0·36	1·90	22·93	16·33
Lambrook Station, Fairlie	1·34	8	0·51	2·18	20·58	18·31
Benmore Station, Clearburn	2·02	11	0·80	1·93	18·05	17·95
Oamaru	0·74	6	0·28	1·64	19·53	16·08
Queenstown	3·96	18	0·97	2·54	26·89	21·97
Clyde	1·12	10	0·38	1·05	10·39	10·50
Dunedin	2·90	19	0·61	2·75	34·35	26·88
Wendon	3·65	16	0·72	2·42	23·16	21·69
Balclutha	2·86	16	0·50	1·89	26·18	18·16
Invercargill	5·19	24	0·55	3·24	35·37	33·02
Puysegur Point ..	19·17	28	2·55	6·36	76·63	61·71
Half-moon Bay ..	10·14	25	1·39	5·02	42·88	42·94